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March 6, 1951 F. J. DOFSEN ET AL 2,544,140

PROCESS OF FORMING AN ARTICLE FROM AT LEAST TWO PLASTICS

Filed Dec. 9, 1947 2 Sheets-Sheet 1

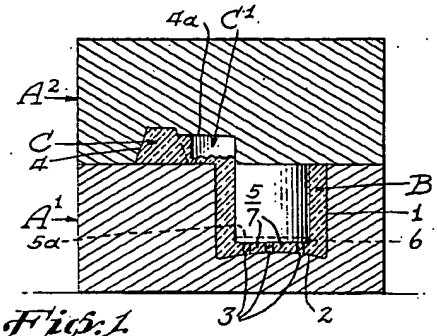


Fig. 1.

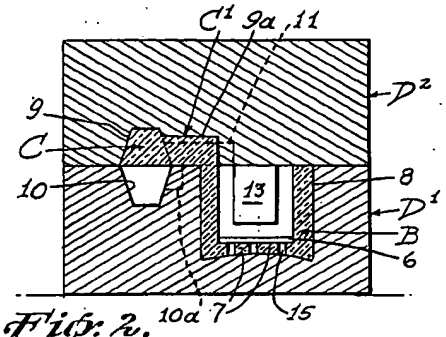


Fig. 2.

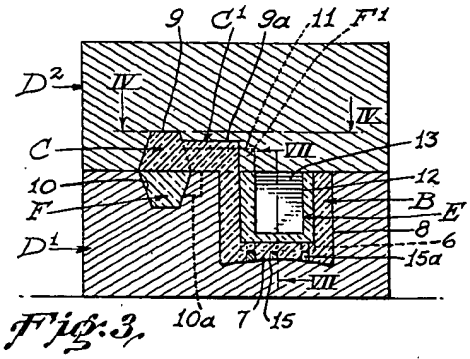


Fig. 3.

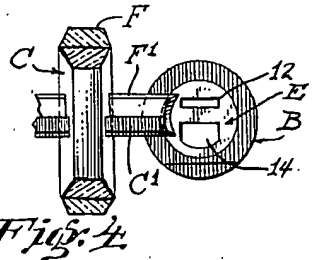


Fig. 4.

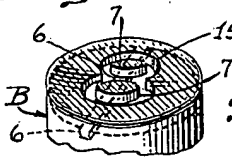


Fig. 5.

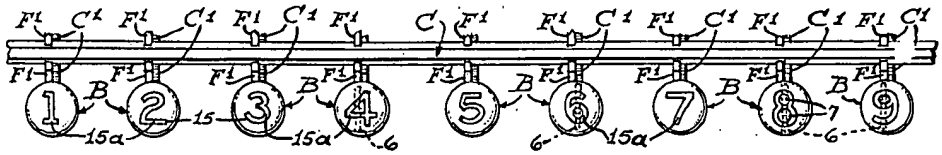


Fig. 6.

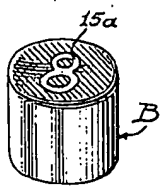


Fig. 8.

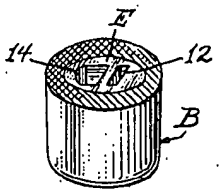


Fig. 9.

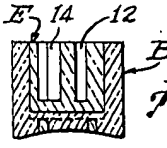


Fig. 7.

INVENTOR.
FLOYD J. DOFSEN AND
ELMER L. DANIELSON.
BY
Munn, Liddy & Glascock
ATTORNEYS.

March 6, 1951 F. J. DOFSEN ET AL 2,544,140

PROCESS OF FORMING AN ARTICLE FROM AT LEAST TWO PLASTICS

Filed Dec. 9, 1947 2 Sheets-Sheet 2

Fig. 10.

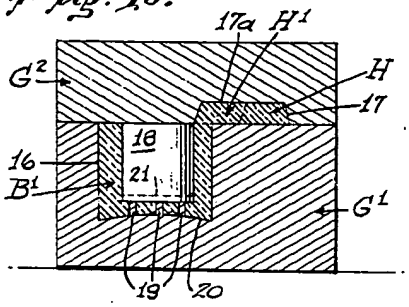


Fig. 11.

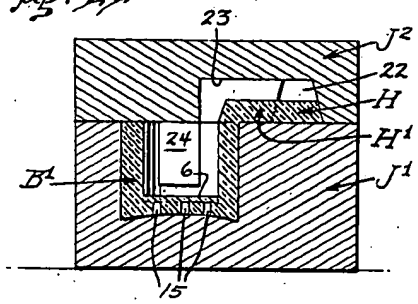


Fig. 12.

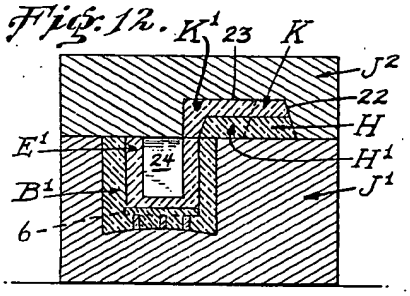


Fig. 13.

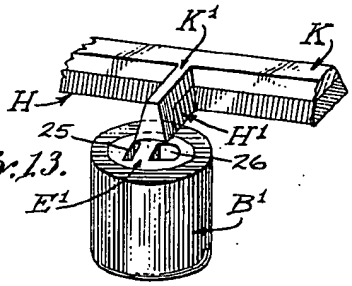
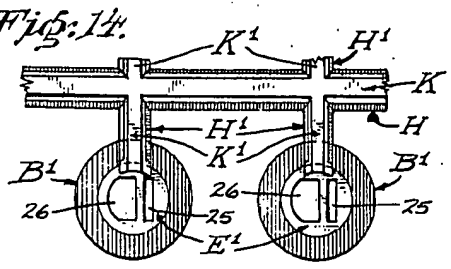


Fig. 14.



INVENTOR.
FLOYD J. DOFSEN &
BY ELMER L. DANIELSON.
Munn, Liddy & Glascock
ATTORNEYS.

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UNITED STATES PATENT OFFICE

2,544,140

PROCESS OF FORMING AN ARTICLE FROM AT LEAST TWO PLASTICS

Floyd J. Dofsen, Millbrae, and Elmer L. Danielson, Oakland, Calif.

Application December 9, 1947, Serial No. 790,676

3 Claims. (Cl. 18—59)

1

The present invention relates to a process for forming an article from at least two plastics. It consists of the steps of the process hereinafter described and claimed.

An object of our invention is to provide a process for forming an article from at least two plastics, which embody improvements over the form of the invention shown in our copending application on a Process and Apparatus for Bonding Thermoplastic Materials, Serial No. 761,128, filed July 15, 1947, now Patent No. 2,492,973. In the copending application, one part of the article is cast in a mold so that a plurality of these parts will be interconnected to each other by a runner, and branch runners will extend from the main runner to the individual parts. The runner and its branches interconnect all of the parts as a unit at the completion of the first casting operation and then the device is removed from the first mold and placed over a plurality of cavities in a second mold corresponding in number to the number of parts, the parts being positioned above the cavities. The parts then are severed from their branch runners and drop into their respective cavities by gravity. The second mold then is closed and a second plastic forced into the cavities to combine with the cast articles already disposed therein and produce a completed article comprising two different plastics.

The principal object of our invention is to do away with the necessity of severing the parts from the branch runners after the first casting and dropping them into the cavities of the second mold. We have found it possible to manufacture the two-plastic articles by casting a plurality of the article bodies in one mold, these bodies being connected to each other as a unit by the main and branch runners. The bodies can be lifted from the first mold as a unit and transferred to a second mold having a plurality of cavities for receiving the precast bodies and also having grooves for receiving the precast main and branch runners. The second mold is provided with an additional groove and branch grooves paralleling the grooves receiving the precast runner and its branches. The additional grooves in the second mold have their outer faces closed by the precast runners when the second mold is closed. The injection of a second plastic into the second mold will form the other part of the plastic article; and then upon opening the second mold, the completed two-plastic articles can be removed with their integral two runners and their branch runners as a single unit. The articles then may be separated from their branch runners, thus

2

completing the manufacture of the two-plastic articles.

In the forming of the bodies in the first operation, the mold may form recesses in the outer surface of the bodies and these recesses will be filled with the second plastic during the second molding operation.

The present invention is also an improvement over the invention shown in another copending application on a method and apparatus for severing sprues from a molded part and simultaneously molding a second plastic to the part. That application was filed August 26, 1947, and the serial number is 770,594 and is now Patent No. 2,510,091. In that application the several plastic parts going to make up a plurality of articles are cast simultaneously and are inter-connected by a runner and branch runners. These precast parts then are transferred to a second mold having a groove and branch grooves for receiving the precast runner and its branches. The closing of the two parts of the second mold prior to the injection of the second plastic, severs the branch runners from their parts. At the completion of the second molding operation, the branch runners formed during the second injection of plastic must be severed from the completed articles. This requires two distinct steps of severing branch runners from plastic articles at two separate time intervals; the first being accomplished upon the closing of the second mold, and the second being carried out after the articles are removed from the second mold. In the present invention, a single severing of both branch runners, one to each plastic, at the same time is accomplished after the two-plastic articles and their runners are removed from the second mold.

Another advantage of holding the precast bodies of the articles to a main runner while transposing them from one mold to a second mold lies in the fact that all of the bodies are retained in a particular position with respect to each other while being transferred and, therefore, the addition of the second plastic to the articles will cause it to form bores in the proper position with respect to the bodies. In the case of making keys, for example, where the characters on the keys are initially formed as slots in the bodies during the first casting operation, the subsequent addition of the second plastic to fill the slots and also to fill a portion of the key interiors can be made with the keys in their same relative positions and, therefore, the provision of key shank-receiving bores in the keys can be ar-

ranged in proper relation with respect to the characters.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

Our invention is illustrated in the accompanying drawings forming a part of this application, in which:

Figure 1 is a transverse section through our first mold showing the casting of the plastic body of the article;

Figure 2 is a transverse section through a second mold and illustrates the placing of the precast body and its main and branch runners in position ready for the second molding operation;

Figure 3 is a transverse section through the second mold and shows the completion of the second molding operation;

Figure 4 is a bottom plan view of the completed article, looking in the direction of the arrows IV—IV in Figure 3, the article shown attached to the two branch runners and removed from the mold;

Figure 5 is a perspective view of the top of an article as it appears after the first casting operation;

Figure 6 is a top plan view of a plurality of the articles interconnected by the runners and branch runners formed of the two plastics;

Figure 7 is a transverse section taken along the line VII—VII of Figure 3, and shows the completed article when removed from the second mold and freed from its branch runners;

Figure 8 is a top perspective view of the completed two-plastic article;

Figure 9 is a bottom perspective view of the same article;

Figure 10 is a transverse section of a mold used in making the first part of a modified form of the article;

Figure 11 is a transverse section through a second mold and shows the precast article from the modified first mold placed therein;

Figure 12 is a view similar to Figure 11 and illustrates the complete two-plastic article at the end of the second molding operation;

Figure 13 is a perspective view of the bottom side of the completed modified article still attached by two branch runners to the two main runners; and

Figure 14 is a bottom plan view of two of the completed modified articles interconnected to each other by the branch and main runners.

While we have shown only the preferred forms of our invention, it should be understood that various changes or modifications may be made within the scope of the appended claims without departing from the spirit and scope of the invention.

In carrying out our invention, we provide a mold in Figure 1 comprising a lower half A1 and an upper half A2. The lower mold half has a plurality of cavities 1 provided therein, although we show only one cavity in Figure 1. Any type of plastic article can be formed and we have shown the cavity shaped to form the body B of a key. The key may have any desired character on its concave face and, therefore, we show the bottom of the cavity as being made convex at 2 and provided with a projection 3 to form the desired character. The character chosen to be represented is the number "8" and a cross section through the mold will show the projection 3 as composed

of three portions representing the top, middle and bottom of the number "8."

The upper mold half A2 has a longitudinally-extending groove 4 therein that has inclined sides so that any thermoplastic which sets in the groove may be readily removed therefrom due to the draft or inclination of the sides. The groove 4 has branch grooves 4a extending laterally therefrom at an angle and these branch grooves communicate with the cavities 1 in the lower mold half A1 as indicated in Figure 1. When the two halves of the mold are closed and the plastic is injected from one end of the mold into the groove 4, it will flow along the groove and then into the branch grooves 4a and finally into the cavities 1 to form the bodies B of the keys.

The upper mold half A2 carries depending cores 5 that enter the cavities 1 and cause the plastic to form hollow bodies. Each body will have a slot in its outer concave surface corresponding to the shape of the character formed by the projection 3 and extending up to the end of the core 5. In the forming of an entirely enclosed circular character, such as the number "8," a bridge 6 must be formed, see Figure 5, so as to support the central portions 7 of the number. The lower end of the core 5, therefore is provided with a groove 5a and the plastic in the first molding operation will fill this groove to form the bridge 6. The top portion of the key body is indicated at B in Figure 5 and the bridge 6 is clearly shown connecting and supporting the central portions 7 of the number "8" to the body.

The injection of the plastic at one end of the mold will cause a runner C to be formed in the groove 4 and branch runners C1 or sprues to be formed in the branch grooves 4a. The branch runners will be integral with the key body B. When the plastic has set, the mold is opened and the runner C will lie on top of the lower mold half A1 where it may be readily removed from the mold and will carry with it the bodies B. Figure 6 illustrates how branch runners or sprues C1 project from both sides of the main runner C so key bodies B can be cast on both sides of the main runner.

In Figure 2, we show a second mold comprising a lower half D1 and an upper half D2. The lower half has cavities 8 therein for receiving the precast plastic bodies B and the upper mold half has a groove 9 therein for receiving the runner C and branch grooves 9a for receiving the branch runners or sprues C1. In addition, the lower mold half D1 has a groove 10 paralleling the groove 9 when the two halves of the second mold are closed and the groove 10 is substantially the same in cross sectional dimensions and shape as the groove 9. The arrangement is such that when the second mold is closed the outer face of the runner C will close the top of the groove 10. Figure 2 represents the second mold with the key body B and its runner in position just prior to the injection of the second plastic.

In Figure 3 we show the same mold as in Figure 2 and further illustrate the completed injection of the second plastic. It will be noted from Figures 2 and 3 that a branch groove 10a extends from the groove 10 and this groove communicates with a second branch groove 11 that parallels the branch groove 9a and is arranged along its side. If desired, the branch groove 11 may be of less depth than the groove 9a and this is indicated in Figure 3. This arrangement allows the branch runners or sprues C1 to project into the branched grooves 9a above the tops of

the branch grooves 11, thus holding the branch runners C1 relating to the mold half D2. The branch groove 11 extends to the cavity 8 at a point where the second plastic may be injected into the interior of the key body B.

A bore 12, see Figure 9, for receiving a key shank, not shown, is formed in the key and this is accomplished by providing a core member 13 of the shape of the desired bore 12, this core member being carried by the upper mold half D2 and extending into the interior of the body B of the key. A second core, not shown, and carried by the upper mold half D2 may enter the interior of the key body to form a recess 14 that is arranged along the side of the bore 12. In making the second plastic injection, the two halves D1 and D2 of the second mold are closed and a second plastic, preferably of a different color from the first, is forced into the groove 10 of the lower mold half D1 and will flow along this groove to form a runner F and into the branch grooves 10a which communicate with the branch grooves 11 in the upper mold half D2. The second plastic in the branch grooves will form the branch runners or sprues F1. From the branch grooves 11, the second plastic will flow into the interior of the key body B and will form a key plug E or insert that will have the bore 12 and the recess 14 formed therein.

It will be seen from Figure 3 that a portion of the second plastic will fill the slot 15 formed by the projection 3 to form the character 15a on the key, such as the number "8." When the recess 15 is filled with plastic, the bridge 6 will be concealed with the result that the number "8" will appear on the top of the key and be of a different color than the key body. This number is shown at 15a in both Figures 6 and 8. As soon as the second plastic has set, the second mold may be opened and the completed keys with their runners C and F and branch runners C1 and F1 removed therefrom as a unit. The resulting article of manufacture is shown at Figure 6.

The flowing of the second plastic in the grooves 10 and branch grooves 10a and 11 will form the second runner F which will parallel the first runner C and will also form branch runners or sprues F1 which will parallel the branch runners C1. Figure 4 illustrates how the branch runners F1 are arranged along the sides of the branch runners C1, while Figure 3 illustrates how the runner F is positioned under the runner C. The completed two-plastic keys may be readily removed from the branch runners C1 and F1 by breaking the keys therefrom at the points where the branch runners or sprues join the keys. The finished keys are shown in Figures 7 to 9, inclusive.

One advantage of retaining the key bodies on the branch runners C1 is to maintain the recesses 15 forming the different characters on the keys in proper relation with respect to each other and the molds. When now the second plastic is injected into the second mold after the key bodies and their runners have been placed in the second mold, the formation of the bores 12 in the key plugs or inserts E will dispose the bores in their proper relation with respect to the characters 15a on the keys. The mounting of the keys on the key shanks, not shown, of the machine will dispose the key characters in their proper positions on the key board.

Another advantage of injecting the second plastic so that the runners and branch runners F and F1 will parallel the runners and branch runners C and C1, lies in the fact that the keys may be severed from both branches C1 and F1 with substantially the same ease as if only one branch runner were being severed. The key bodies B act as the cavities for receiving the second plastic to form the inserts E.

In Figures 10 to 14, inclusive, we show a slightly modified form of the invention. The mold illustrated in Figure 10 consists of a lower half G1 and an upper half G2. The latter has a plurality of cavities 16 therein. These cavities are in the shape of the articles to be cast and we have indicated these articles as being key bodies B1. The upper half G2 has an elongated groove 17 with branch grooves 17a leading therefrom and communicating with the cavities 16. Cores 18 are carried by the upper mold half G2 and there are as many cores as there are cavities 16. The cores extend into the cavities as illustrated. The lower half G1 has a projection 19 in the shape of the desired key character, such as the number "8," and this projection extends above the convex bottom 20 of the cavity. The lower end of the core 18 has a diametrically-extending groove 21 for forming the bridge 6 shown in Figure 5.

The first operation is the injection of the plastic material under the desired pressure at the end of the mold and the material is directed into the groove 17, branch grooves 17a and cavities 16, to form an elongated runner H with branch runners or sprues H1. The branch runners or sprues are connected to the key bodies B1 so that opening of the mold will permit the exposed runner H to be removed and carry with it the key bodies connected thereto. This completes the first operation of forming the keys. The key bodies are hollow and will have slots or recesses 15 in their concave tops corresponding to the desired characters which are to be formed in the keys.

Figure 11 shows the second mold comprising the lower half J1 and the upper half J2 in cross section. The runner H is received in a groove 22 formed in the upper half and the branch runners H1 are received in branch grooves 23. It will be noted that the elongated groove 22 is deeper than the thickness of the runner H; also, the branch grooves 23 are deeper than the thickness of the branch runners H1. This arrangement provides the groove 22 with an interior space for receiving the second plastic material and likewise the branch grooves 23 are made deep enough to have an interior space for receiving the second plastic material.

Figure 12 illustrates the completion of the second operation in flowing of the second plastic material under pressure into the portion of the groove 22 that has been left open by the runner H. The second material forms a runner K that overlies the runner H. The second plastic will flow into the portions of the branch grooves 23 not occupied by the branch runners H1 and will form branch runners or sprues K1 that are superimposed on the branch runners H1. The grooves 22 and 23 are formed in the upper mold section J2. This mold section carries core members 24 that project into the hollow interior of the key bodies B1. The second plastic will flow into the hollow key bodies and surround the core members 24. At the completion of the second molding operation, the mold may be opened and the completed keys with their runners removed as a unit.

The core members 24 will form the key shank-

receiving recesses 25 shown in Figure 14. The recess 25 is shaped so as to receive the key shank, not shown, of the machine using the keys. Other core members, not shown, will form the recesses 26 in the key plugs or inserts E1. In Figure 13, we show the runners H and K in perspective and the runner H has been shaded to indicate a different color from that of the runner K. The same figure also shows the branch runners H1 and K1 and it will be seen that the branch H1 is integral with the key body B1, while the branch K1 is integral with the key plug or insert E1. This form of the invention has all of the advantages enumerated for the form shown in Figures 1 to 9, inclusive.

The difference between the two forms lies in the fact that the two runners and their branch runners or sprues are superimposed one above the other in Figures 12 to 14, inclusive, while in the form shown in Figures 1 to 9, inclusive, the branch runners or sprues are arranged side by side. Furthermore, the two runners and their branches in the form shown in Figures 10 to 14, inclusive, are formed from grooves provided in the upper mold half G2, whereas in the first form of our invention, the second runner F is formed in the lower mold section. By arranging the branch runners one above the other as indicated in Figure 13, it is easier to break the completed keys from their branches than where the branch runners are arranged side by side.

We claim:

1. The herein described method of forming an article from more than one plastic consisting of placing a preformed plastic structure comprising a hollow body with a slot extending therethrough, a main sprue and a branch sprue connecting the body and main sprue into a mold having channels of greater size than said first mentioned sprues, with said sprues in said channels, of injecting a second plastic through the channels into said slot so that the sprues formed by the second plastic lie adjacent said preformed sprues.

2. The herein described method of forming an article from more than one plastic consisting of placing a preformed plastic structure comprising a hollow body with a slot extending therethrough, a main sprue and branch sprue connecting the body and main sprue into a mold having channels of greater size than said precast sprues with said sprues in said channels, of injecting a second plastic through the channels into said slot so that the sprues formed by the second plastic lie adjacent said preformed sprues and are coextensive therewith.

3. The herein described method of forming an article from more than one plastic consisting of placing a preformed plastic structure comprising a hollow body with a slot extending therethrough, a main sprue and a branch sprue connecting the body and main sprue into a mold having channels of greater size than said first mentioned sprues with said sprues in said channels, of injecting a second plastic through the channels into said slot so that the sprues formed by the second plastic will extend alongside the sprues of the first plastic in contacting relation therewith.

FLOYD J. DOFSEN.
ELMER L. DANIELSON.

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United States Patent [19]

Boehm et al.

[11] **Patent Number: 4,460,534**

[45] **Date of Patent: Jul. 17, 1984**

[54] **TWO-SHOT INJECTION MOLDING**

[75] Inventors: **Russell W. Boehm; William R. Keelen**, both of Boulder County, Colo.; **Herbert Rees**, Dufferin County, Canada

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **415,771**

[22] Filed: **Sep. 7, 1982**

[51] **Int. Cl.**³ **B29C 7/00**; B29D 9/00; B29F 1/12

[52] **U.S. Cl.** **264/246**; 264/250; 264/268; 264/269; 264/334

[58] **Field of Search** ..... 264/161, 163, 245, 246, 264/247, 250, 255, 334, 513, 241, 267-269; 425/556, 557, DIG. 34

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Primary Examiner—Willard E. Hoag
Attorney, Agent, or Firm—Francis A. Sirr

[57] **ABSTRACT**

The complete, two-color, multiple keybutton array of a keyboard is molded by a two-shot injection molding method which uses a rotating, double female die means selectively cooperating with two male dies. The finished keybutton array is ejected to a carrier which then cooperates with a gathering fixture, which fixture is then movably adjusted to place the keybuttons in position for assembly to the keyboard.

13 Claims, 17 Drawing Figures

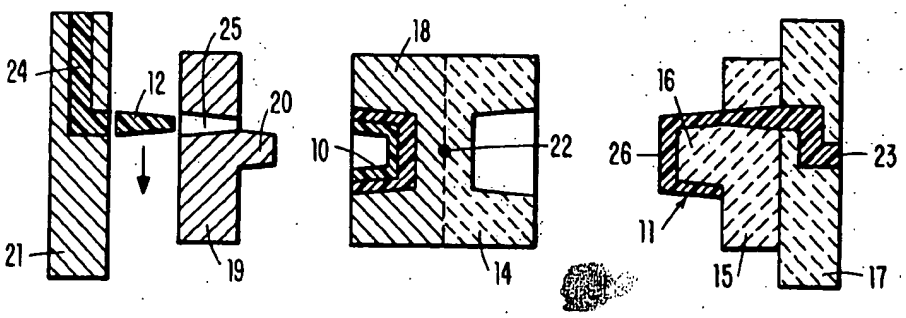


FIG. 1

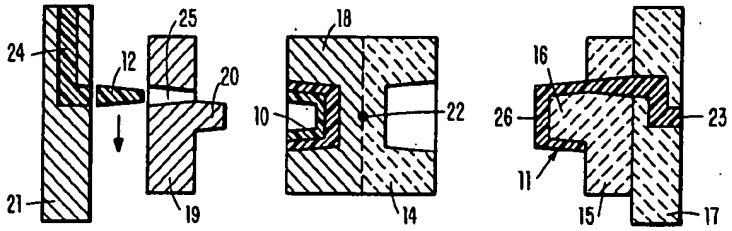


FIG. 2

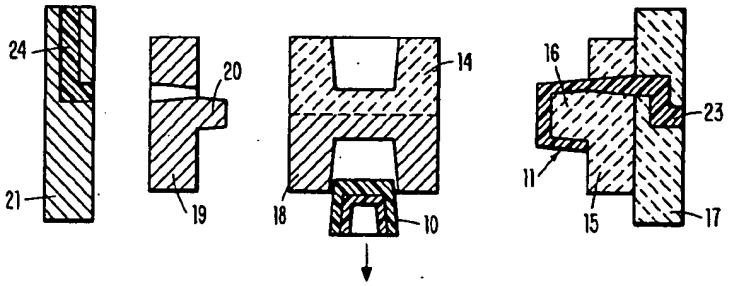


FIG. 3

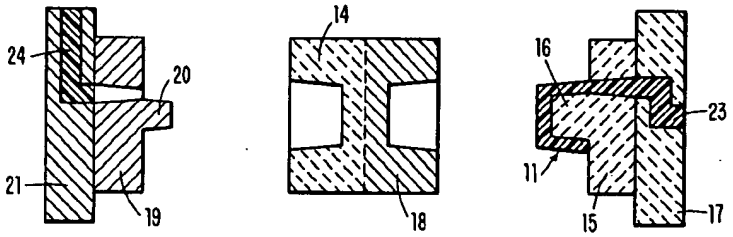


FIG. 4

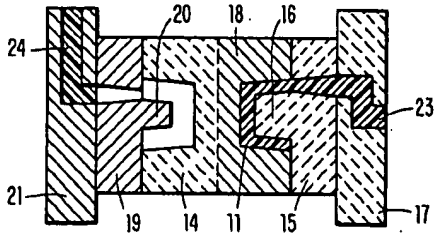


FIG. 5

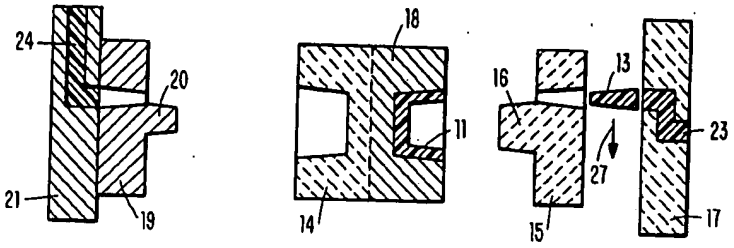


FIG. 6

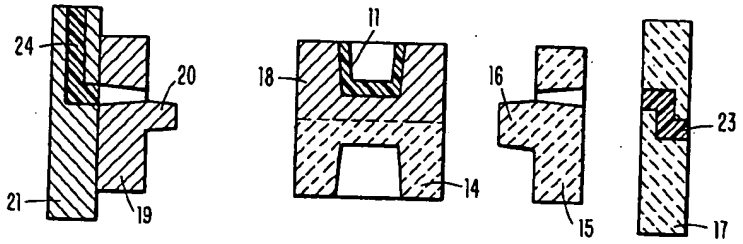


FIG. 7

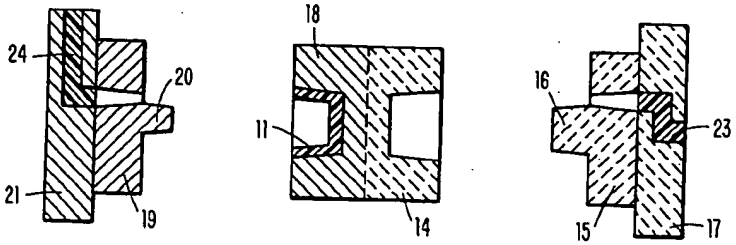


FIG. 8

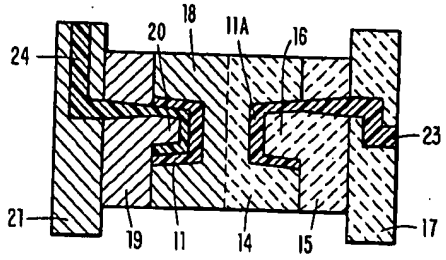


FIG. 9

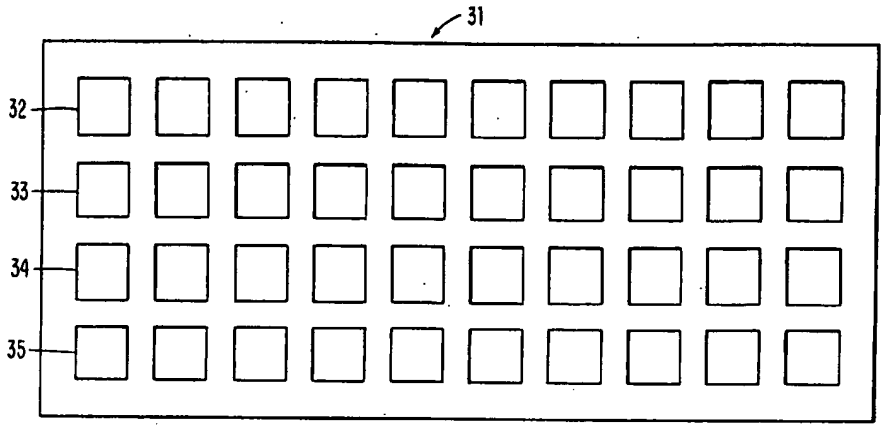


FIG. 11

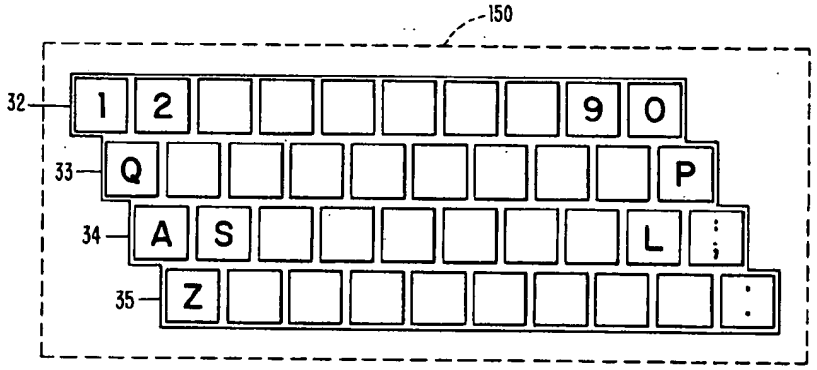
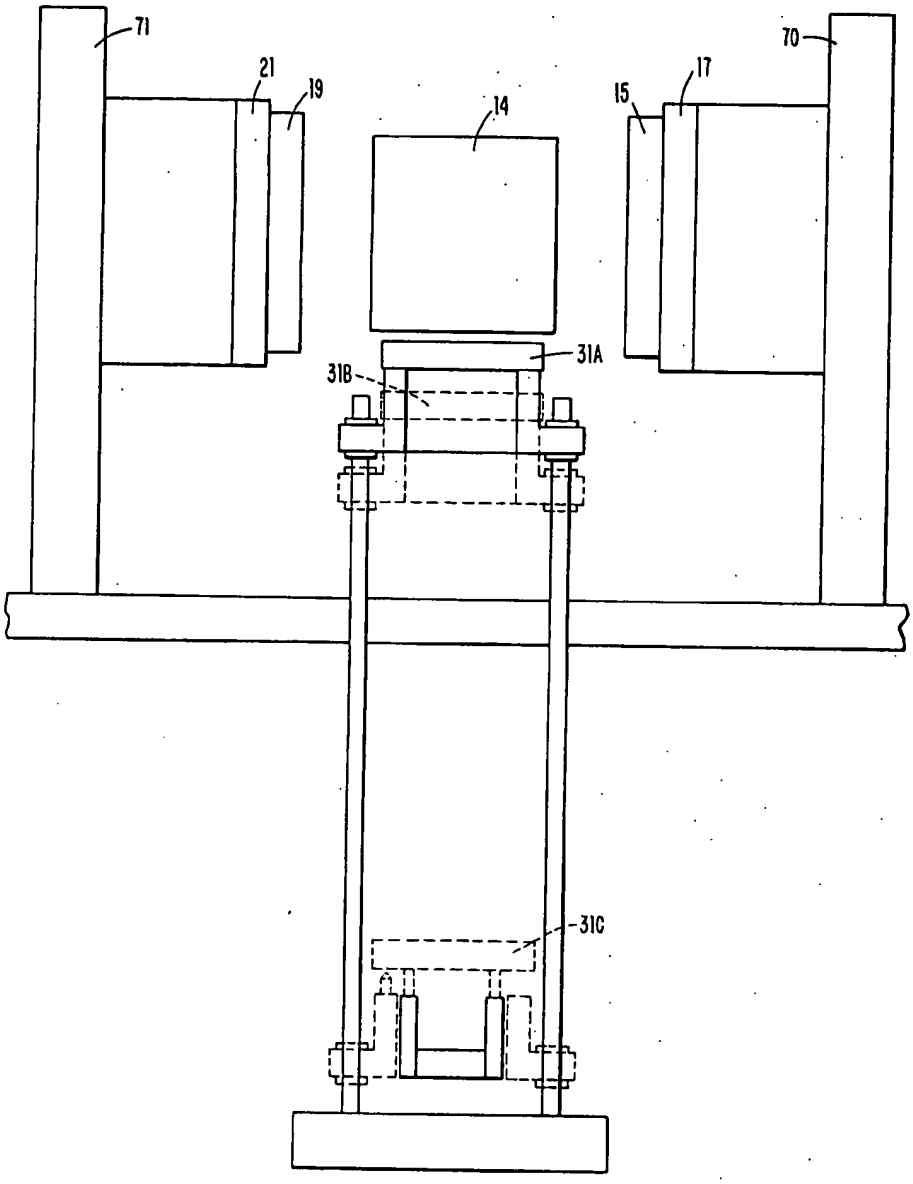


FIG. 10



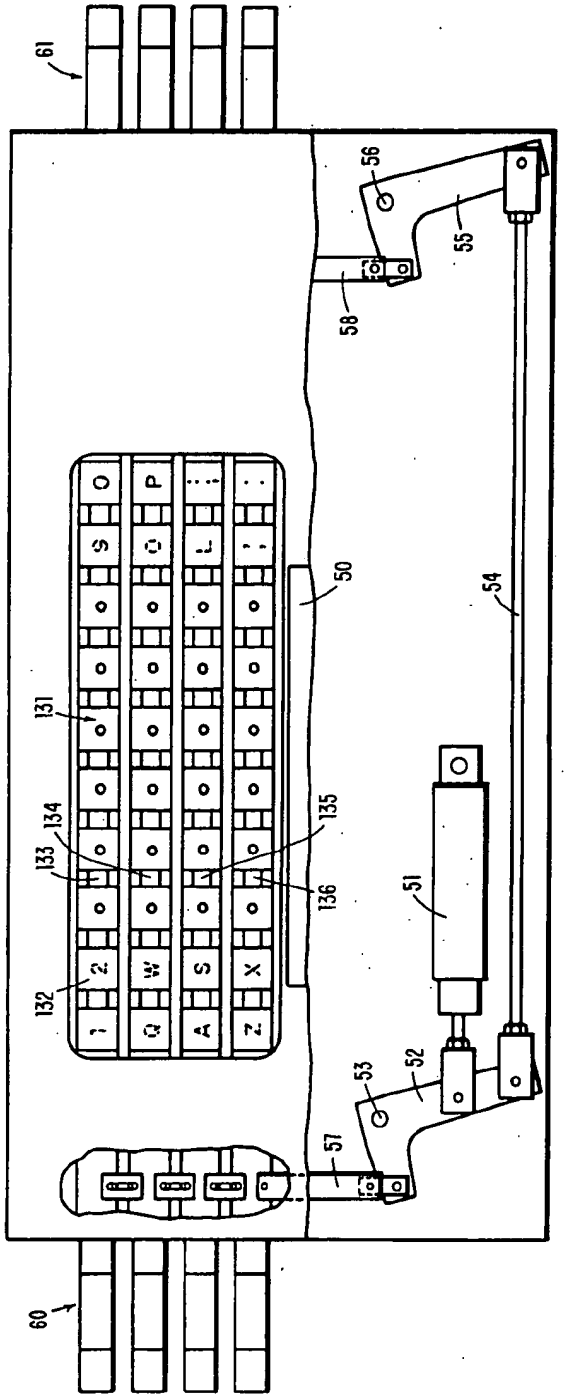


FIG. 12

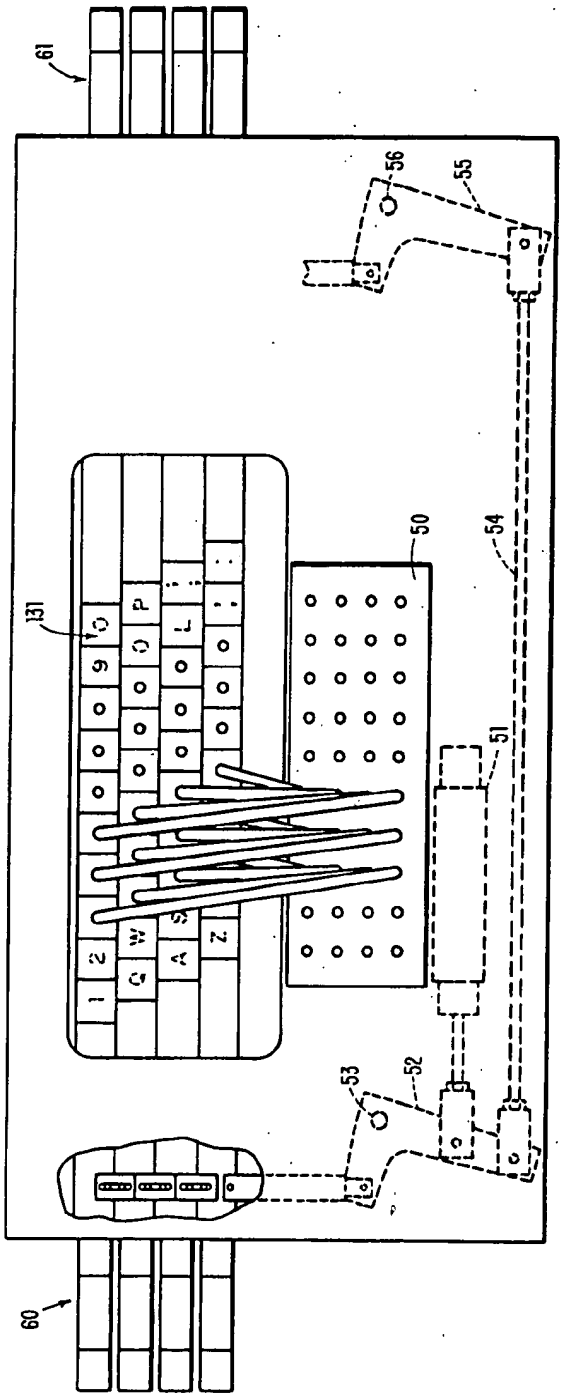
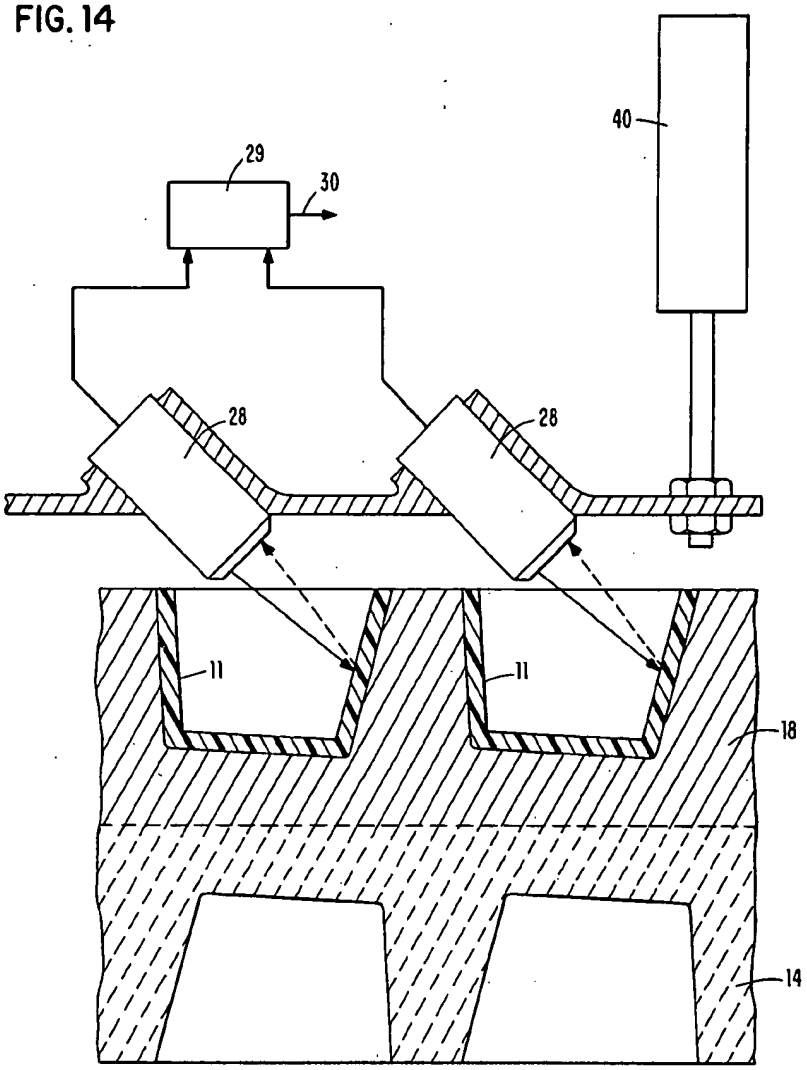


FIG. 13

FIG. 14



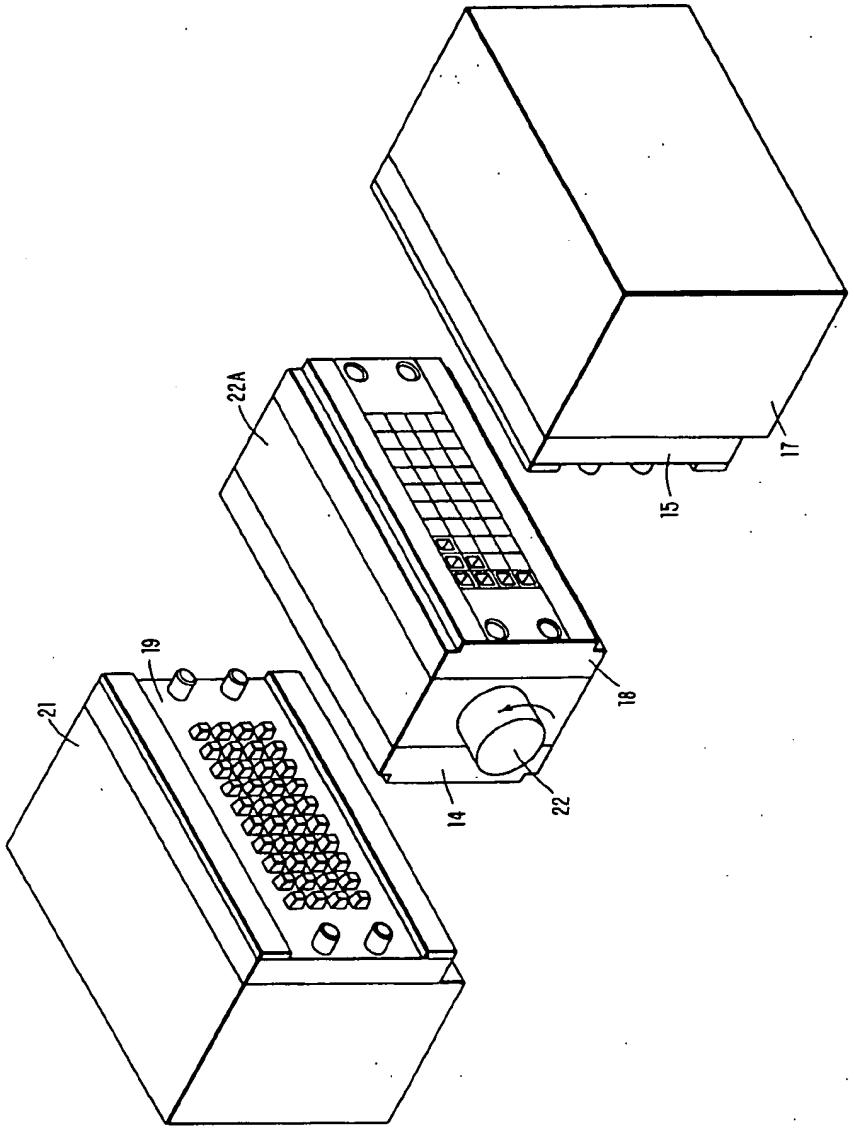


FIG. 15

FIG. 16

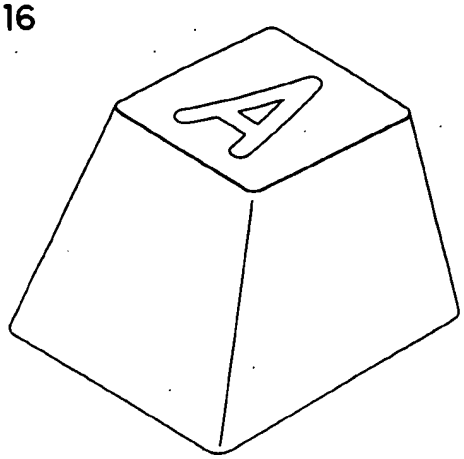
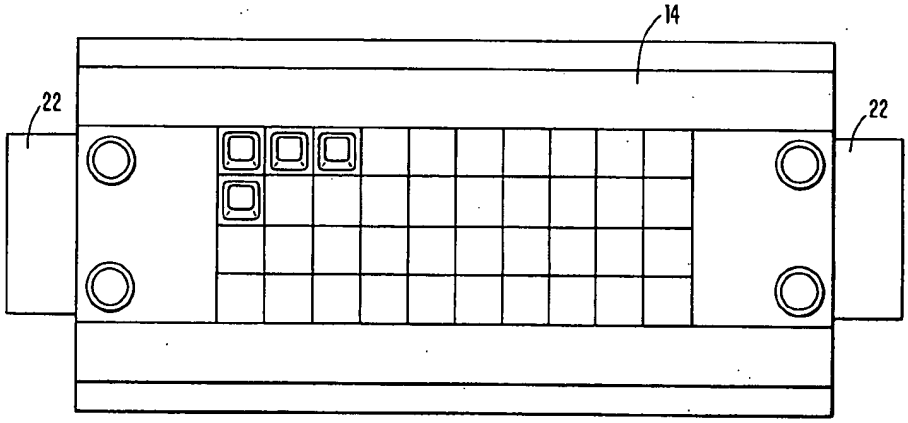


FIG. 17



TWO-SHOT INJECTION MOLDING

TECHNICAL FIELD

The present invention relates to two-shot injection molding of a plastic article such as a typewriter keybutton having two externally visible colors, one of which is the keybuttons's character indicia.

BACKGROUND OF THE INVENTION

The present invention relates to that type of two-shot injection molding wherein the first shot forms the keybutton's exterior surface or shell, including a void in the shape of the desired keybutton character. This is "shell-first" two-shot injection molding. U.S. Pat. Nos. 2,544,140 and 2,663,910 are exemplary.

The use of two male dies and one female die to form such a shell-first article is taught by, for example, U.S. Pat. Nos. 2,765,555 and 3,031,722. In these patents, the first shot forms the article's shell and character voids. The first male die is then withdrawn from the shell. The article's shell is held by the female die as a second, somewhat smaller, male die is mated therewith. The second shot now fills the inside of the article, i.e., molds the article's core as well as the character voids, with a different color material.

In U.S. Pat. No. 3,164,864 a keybutton is molded "core-first" by means of a single male die which is used with a first-shot female die. The first female die is then withdrawn, leaving the keybutton's core on the male die. This core includes the keybutton's character as a raised surface. The male die is now mated with a somewhat larger female die, and second-shot molding forms the keybutton's shell. This shell surrounds but does not cover the keybutton's raised character.

The use of rotary and/or movable mold dies to facilitate two-shot molding is also known in the prior art.

A first example is U.S. Pat. No. 3,173,176 where a rotary die-carrying mechanism produces two-color typewriter keys. In this device a plurality of upper dies carries the first-shot molding from the first-shot injector to a second-shot injector.

A second example is U.S. Pat. No. 3,178,497 where a reciprocating male die mechanism carries the first-shot-molding from a first female die, to a second female die, for second-shot-molding.

A third example is U.S. Pat. No. 4,165,959 where a rotary two-injector mechanism first injects into a shell-first mold. The mold then opens, holding the first shot in the mold cavity. A reciprocating mold plate now moves from a first to a second position, thus changing the mold from a first to a second cavity configuration. The mold closes, and the article's core is molded using the second injector.

SUMMARY OF THE INVENTION

As above mentioned, the present invention relates to shell-first injection molding of a two-material, or two-color article.

The present invention will be described using as an example a two-surface, or stack mold as seen in FIG. 1. Conventionally, mold members 17, 15, 14, 18, 19 and 21 (reading right to left in FIG. 1) would normally be called members A, B, C, D, E and F, respectively, of a single mold. However, in the following description, members 14, 15 and 17 will be called the "first mold", and members 18, 19 and 21 will be called the "second mold".

The novel features of the present invention include a construction and arrangement which automatically unloads the article's shell from a first-shot male die, severing the article's sprue runner, as the shell is loaded into a second-shot female die, where it is held by the force of vacuum (FIG. 5). The second-shot female die then transports the article's shell to a second-shot male die, for second-shot-molding of the article's core (FIG. 8). As the second-shot mold thereafter opens, the article's second-shot sprue runner is severed, and the finished article is held in the second-shot female die by force of vacuum (FIG. 1). The second-shot female die lastly moves to a discharge position to unload the finished article (FIG. 2).

More specifically, a center-disposed, rotatable, twin-female die houses one female die for the keybutton's exterior shell, and a second female die for holding the keybutton's exterior shell as the keybutton's core is molded. In this manner, one keybutton shell is second-shot-molded, as the next keybutton's shell is simultaneously first-shot-molded (FIG. 8).

With this arrangement, the sequence of operation can be considered to begin as the two molds simultaneously open, leaving a finished keybutton vacuum-held in the second mold's female die, and leaving a molded keybutton shell on the first mold's male die (FIG. 1).

The twin-female-die means now rotates 90° (FIG. 2) (CCW, for example). In this position, the second female die holds the finished keybutton disposed vertically downward. The finished keybutton is now ejected. Both female dies are now empty.

The twin-female-die means now rotates another 90° in the same direction (FIG. 3). Both molds then close, inserting the first male die into the second female die, and inserting the second male die into the first female die. The previously molded keybutton shell is thus loaded into the second female die (FIG. 4). Vacuum force is applied to hold the shell in the second female die, and the mold opens, severing the sprue runner (FIG. 5). Both male dies are now empty.

The twin-female-die means now rotates another 90° (FIG. 6). Vacuum continues to hold the keybutton shell in the second female die, vertically disposed upward. A photoelectric sensor now operates to detect the presence of the keybutton shell in this female die (FIG. 14). If the shell is not properly detected, the process stops.

The twin-female-die now rotates another 90° (FIG. 7), the molds close, as the first male die is inserted into the first female die, and the second male die is inserted into the second female die (FIG. 8). The keybutton shell at the second female die is filled with a contrasting color, thus forming the keybutton's character in the contrasting color. At the same time, another keybutton shell is molded at the first female die.

The two molds now simultaneously open, completing one molding cycle (FIG. 1). Another finished keybutton now exists in the second female die, held there by vacuum force, the first female die is empty, and the first male die now holds the molded keybutton shell for the next keybutton to be manufactured.

Using the above concepts, the present invention additionally provides for the use of such a twin-female-die to mold all of the individual character keys of a typewriter keyboard by way of the aforesaid two-shot injection molding process (FIG. 15). As a result, all keys of such a keyboard simultaneously pass through the afore-

said process steps and are simultaneously ejected vertically downward onto a holding plate, where they are held by vacuum force (FIG. 10). This plate includes an array of shallow holding compartments, and may, for example, comprise an ordered array of ten columns and four rows of such compartments. In accordance with the present invention, this plate then delivers the array to a gathering fixture (FIGS. 12 and 13). The gathering fixture includes four similar rows of compartments which are relatively movable. The present invention causes subsequent movement of these compartments in a manner such that the molded keybuttons are placed in the exact staggered configuration well known to typists (FIG. 11). As such, the keybuttons are ready for assembly to a keyboard.

In describing the present invention, the details of injection molding machine, two-surface or stack molds, mold construction details, rotary molds, photocell details, and the like, will not be shown or described because they are known to those skilled in the art. As exemplary of this fact, the aforesaid prior patents are incorporated herein by reference for the purpose of indicating the background of the present invention, and as illustrative of the state of the art.

In the following drawing, the aforesaid two molds are sometimes shown in section. In order to aid in clarity, the molds are shown with different type section lines.

The foregoing and other features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows the above-described start of the sequence of operation of the present invention, whereat the two molds are open, a finished article **10** is vacuum-held in the second female die **18** of the center-disposed, twin-female-die **14, 18**, a molded shell **11** of the article is held on the first mold's male die **16**, and the second mold's reciprocating mold plate **19** has withdrawn from its manifold mold plate **21**, to thereby sever the second mold's sprue runner **12**.

FIG. 2 shows the twin-female-die subsequently rotated counterclockwise (CCW) 90° such that the finished article **10** is now ejected vertically downward.

FIG. 3 shows the next position where the second mold's reciprocating mold plate has rejoined its manifold plate and the twin-female-die has rotated another 90° CCW.

FIG. 4 shows the next position whereat the molds have closed with the female dies now mated with opposite-type male dies.

FIG. 5 shows the molds subsequently opened, with the first mold's reciprocating mold plate **15** withdrawn from its manifold plate **17**, to thereby sever the first mold's sprue runner **13**, and with the article's shell **11** now vacuum-held in the second mold's female die.

FIG. 6 shows the twin-female-die rotated another 90° CCW, at which time a photoelectric sensor, shown in FIG. 13, operates to detect the presence of shell **11**.

FIG. 7 shows a twin-female-die rotated another 90° CCW, and shows the first mold's reciprocating mold plate rejoined to its manifold plate.

FIG. 8 shows the molds closed, whereat shell **11** is filled with a second molding material, and another shell **11*a*** is formed in the female die **14** of the first mold; the sequence then returns to FIG. 1, and is repeated.

FIG. 9 is a top view of a plate which receives the array of molded keybuttons in a four-row configuration, as these finished parts are ejected, face up, in FIG. 2.

FIG. 10 shows the plate of FIG. 9 in its three separate operative positions **31*a***, **31*b*** and **31*c*** relative the mold.

FIG. 11 shows the output result of the present invention, i.e., a tray **150** whose four rows of compartments hold a typewriter keybutton array with the buttons facing up.

FIG. 12 shows a top view of the gathering fixture, with the top plate broken away to better show the row actuators, which actuators are operable to produce the keybutton configuration shown in FIG. 11.

FIG. 13 is a top view of the gathering fixture, without the top plate broken away, showing the vacuum means which holds the keybuttons in position, against the force of gravity, and showing the keybutton positions adjusted to the FIG. 11 typewriter keybutton array position.

FIG. 14 shows two rows of a four-row, rotary, twin-female-die, in the position of FIG. 6, whereat photocell means operates to detect the presence of all 40 shells in the corresponding 40 female dies of the second female die.

FIG. 15 is a perspective view of a multiple mold assembly, in the position of FIG. 3 whereby the plural individual keybuttons of an entire keyboard are molded in one cycle of the present invention.

FIG. 16 is a face-up perspective view of an exemplary keybutton to be molded by the present invention.

FIG. 17 is a plan view of FIG. 15's female die **14**, showing a few of the die cavity outlines.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The term "first mold" will include female die **14**, manifold plate **17**, and reciprocating mold plate **15** which carries male die **16**. Likewise, the "second mold" will comprise female die **18**, manifold plate **21**, and reciprocating mold plate **19** which carries male die **20**.

The two female dies **14, 18** are formed as a unitary assembly and rotate about an axis **22**. These dies include an appropriate plate **22*a*** (FIG. 15) therebetween, to facilitate the routing of vacuum lines and cooling water passages. As will be apparent, this rotation occurs in 90° steps, and in the counterclockwise (CCW) direction as shown in FIGS. 1-8.

For purposes of description only, the injection-molding material **23** is a gray-colored material, and the injection-molding material **24** is a white material.

It is convenient to describe the present invention by "stopping" the process in the condition shown in FIG. 1. In this condition, female die **14** is empty, and female die **18** holds a finished article, such as keybutton **10**. Both molds are open and reciprocating mold plate **19** has moved away from manifold plate **21**, thereby severing the white sprue runner **12** which just previously occupied sprue **25** in plate **19**. In addition, shell **11** of a keybutton identical to keybutton **10** is now contained on the male die **16** of reciprocating mold plate **15**.

As is well known to those of skill in the art, male die **16** and female die **14** are constructed and arranged such that shell **11** includes a character, such as the character "A" in its face **26**, see FIG. 16. In addition, female die **18** is constructed and arranged to snugly hold the exterior surface of shell **11**, without obstructing the void "A." Male die **20** is of the same general shape as male die **16**.

However, die 20 is smaller in size such that material 24 may fill the interior cavity of shell 11, and flow into the void defining the character "A" thereby filling this void and providing a white character "A" which is surrounded by a gray shell. Finished keybutton 10 of FIG. 1 is such a keybutton.

For simplicity, the arrangement of FIGS. 1-8 shows the molding of a single keybutton. It is within the present invention to provide a plurality of some 40 unique keybuttons wherein the unitary assembly of first and second female dies 14 and 18 includes 40 distinctively different dies to form the conventional keyboard array as shown face-up in FIG. 11. In this case, 40 distinctly different male dies 16 and 20 are provided.

The next step of the present invention is shown in FIG. 2. Female die assembly 14, 18 has rotated 90° CCW and ejection means (not shown) ejects finished part 10 vertically downward into a gathering fixture to be described later. This ejection may be accomplished by terminating the second female die's vacuum-hold, or by changing it from a negative to a positive pressure.

In FIG. 3, the female dies have rotated another 90° CCW, both die cavities are empty, and mold plate 19 has rejoined manifold plate 21.

The molds now close, as shown in FIG. 4. The cavity formed by female die 14 and male die 20 is empty. Injection does not take place at this time. Rather, a vacuum force conduit, within second female die 18, is activated to provide a force holding shell 11 within this female die cavity. Therefore, when the molds again open, as shown in FIG. 5, shell 11 is retained in female die 18, as it is severed from sprue runner 13. Mold plate 15 withdraws from manifold plate 17, and runner 13 is ejected, as represented by arrow 27.

The twin-female-die assembly now rotates a further 90° CCW, to the position shown in FIG. 6. In this position it is desirable to check that each of the female die cavities 18 actually contains a shell 11. If a failure occurs, and a cavity if no occupied by a shell 11, subsequent injection molding of the white-color material 24 into an empty cavity will cause the molding material to enter the vacuum conduit, above-mentioned, thus fouling the conduit. Therefore, the process is terminated should a shell(s) not be detected.

FIG. 14 shows a twin-female-die assembly having some 80 cavities, 40 on each side, two of which are shown holding shells 11. Associated with each of the cavities of female die 18 is a light source/photoelectric cell couple 28 which is constructed and arranged to direct light to the interior surface of each of its shells 11. If a shell occupies a cavity, the light is not reflected back to a photoelectric cell and an electrical signal (for example zero volts) is generated to network 29. Should any of the cavities not contain a shell 11, light is reflected to its photocell, and a signal on conductor 30 operates to terminate the molding process to prevent fouling of the aforesaid vacuum force conduit.

By way of example, the detectors 28 of FIG. 14 may be the brand SCAN-A-MATIC S351G reflective scanner manufactured by SCAN-A-MATIC INC. These detectors are normally spaced away from the rotatable female die assembly, and are appropriately lowered into the FIG. 14 detecting position by operation of actuator 40, while all such detectors are supported on plate 41.

If all female dies 18 properly hold a shell 11, the assembly 14, 18 again rotates 90° CCW, as shown in FIG. 7, and mold plate 15 rejoins manifold plate 17. The molds now close, as shown in FIG. 8.

Injection now takes place into both cavities. A second shell 14 is formed in the cavity defined by female die 14 and male die 15. The previously molded shell 11 is filled with material 24, as shell 11 resides in the cavity defined by female die 18 and male die 19.

In FIG. 8, injection simultaneously takes place in both cavities. White material 24 is injected in gray shell 11, and another gray shell 11A is molded in cavity 14, 16.

The process now returns to FIG. 1, as the dies open. A finished keybutton is contained within female die 18, and the keybutton shell 11A is contained on male die 16.

In this manner, the cyclic process continually repeats, and for every FIG. 1-to-8 cycle, a finished keybutton (an array of keybuttons) is formed by way of two-shot injection of two-colors.

A further feature of the present invention provides a multicavity female-die assembly 14, 18 which, when disposed in its FIG. 2 position, ejects a number of finished different-character keybuttons, for example 40, onto a plate 31 whose top view is shown in FIG. 9. This plate comprises four rows 32-35, each of which contains 10 shallow, open-top compartments adapted to receive the distinctly different keybuttons of a well-known keyboard. These keybuttons reside on plate 31 face-up. A vacuum force may be used to hold each keybutton in its compartment. This 4×10 orderly array of compartments allows the female-die assembly 14, 18 to be constructed in a similar orderly manner.

FIG. 10 shows plate 31 in its three separate operative positions relative to the molding machine. Position 31*b* is the "wait position" where an empty plate awaits arrival of the FIG. 2 status of the molding operation. When the FIG. 2 status arrives, plate 31 moves up to position 31*a*, where keybuttons are ejected onto the plate from female die 18. After plate 31 is so loaded with a keybutton array, the tray is lowered to position 31*c* for unloading. At this time, plate 131 (FIGS. 12 and 13) moves over plate 31, as plate 31 resides in its position 31*c*, to remove the complete array by way of vacuum-pickup. Thereafter, the unloaded plate returns to position 31*b*.

In FIG. 10, mold members 15, 17 are shown supported on stationary platen 70, whereas mold members 19 and 21 are supported on movable platen 71.

The orderly array of keybuttons now held on plate 131, in FIG. 10's position 31*c* are now rearranged to the familiar keyboard position shown upright in FIGS. 11 and 13. In FIGS. 11 and 13, certain keybuttons carry their respective different indicia. As will be observed, this is the well-known typewriter keyboard.

The top-view, FIG. 12 position of the keybuttons is identical to the orderly array of plate 31 and female die 18. However, tray 131 comprises 40 slidable compartments 132 which are carried on row-slides 133, 134, 135 and 136, corresponding to FIG. 11's rows 32, 33, 34 and 35. Note that the keybuttons still face up. They have been lifted from plate 31, at FIG. 10's position 31C, and are held in position by FIG. 13's vacuum plenum 50, against the force of gravity. The top plate has been broken away in FIG. 12, and as a result, FIG. 13's vacuum plenum 50 is not seen in FIG. 12.

The operation of the mechanism shown in FIGS. 12 and 13 first moves the rows 133-136 together, as shown in the top view of FIG. 13, and then moves the rows laterally, as is also shown in FIG. 13. FIG. 13 also discloses a vacuum plenum 50 which is associated with the individual compartments 132 of tray 131 so as to hold

each of the keybuttons securely in its respective compartment. In FIG. 12, tray 131 is shown with its compartments 132 in positions identical to FIG. 9. In order to move the four rows of tray 131 together, air cylinder 51 is energized. Crank 52 pivots about pivot point 53, as tie rod 54 transmits a similar motion to link 55 which pivots about pivot point 56. As a result, slides 57 and 58 move to bring the horizontal rows together.

Now that the rows have been brought together, two banks of air cylinders 60 and 61 are energized to move the rows to their staggered position, shown in FIGS. 11 and 13.

Tray 131, in its FIG. 13 position, is now mated with an output tray such as represented by outline 150 of FIG. 11. The vacuum force of plenum 50 is released, and the keybuttons gravity-drop onto and into tray 150. This last tray 150 now holds the keyboard array, ready to be assembled to a keyboard.

From the foregoing description it is apparent that the present invention uses a three-plate, self-degating mold design. The keybuttons's outer shell 11 is molded first. This first-shot shell is then auomatically transferred to the second-shot male die 20 via the second-shot female die 18. This transportation is faciliated by the use of back-to-back, first and second shot female dies 14, 18 which are contained in a centrally mounted, rotating mold plate.

The finished keybuttons which make up a keyboard array are then automatically loaded onto an output tray 150 (FIG. 11), significantly lowering labor requirements at a subsequent keyboard assembly facility. Trays 150, which are rectangular in shape, can be packed for shipment to such a facility. Once received, the keybuttons are automatically removed from the trays and assembled to the keyboard.

As mentioned, FIG. 1-8's centrally disposed, rotating female die plate 14, 18 preferably includes as many as 40 distinctively different female die cavities 18. Generally speaking, female die cavities 14 are all of the same shape, since their only requirement is that they hold the keybutton shell, and not interfere with each shell's distinctively different character void.

FIG. 15 shows such a multiple female-die assembly, and FIG. 17 shows one such female die 14.

An exemplary injection molding machine to be used in the practice of the present invention is the Hydraulic Clamp Machine X420 by Husky Injection Molding Systems, Ltd.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention:

What is claimed is:

1. A two-material injection molding method for forming a molded part whose outer surface comprises an image formed of material A, surrounded by a shell of material B, the method comprising the steps of:

providing two female dies, said first female die providing the exterior shape of said molded part including a void defining said image, and said second female die accepting said part's exterior shape without obstructing said voids;

mating said first female die with a first male die and injection molding said material B, to thereby form a material B shell of said molded part, including a void in the shape of said image;

separating said first female die from said first male die, while leaving the material B shell of said molded part on said first male die;

mating said second female die with said first male die while said first male die supports said material B shell;

applying a force between said second female die and the part's material B shell to thereby retain the material B shell within said second female die, as said first male die is separated therefrom;

mating said second female die with a second male die which is similar in size than said first male die, to thereby define a cavity between said second male die and the interior surface of said material B shell; and injection molding the cavity thus formed with material A, to thereby form a finished part.

2. The method of claim 1 including the additional step of separating said second female die from said second male die as the finished part is held in said second female die by operation of said applied force.

3. The method of claim 2 including the step of providing said first and second female dies as a unitary assembly which is rotatable between two positions whereat said first and second male dies are mounted, and including the additional step of providing said first as a vacuum force which extends through a conduit in said second female die.

4. The method of claim 3 including the step of mating said second female die with said second male die, and mating said first female die with said second male die, and thereafter substantially simultaneously molding a second material B shell of said molded part in said first female die, as the prior-molded material B shell in said second female die is interior-filled with material A.

5. The method of claims 1, 2, 3 or 4 wherein said materials A and B are of different colors, wherein said molded part is a keybutton and wherein said image is a keybutton character.

6. The method of claims 1, 2, 3 or 4 wherein the injection into said first and second female dies is effected through a sprue formed in a reciprocating mold plate, and including the step of effective movement of said mold plates to sever the material B sprue runner for said shell, and to sever the material A sprue runner for said finished part.

7. A two-material injection molding method for forming a plurality of different character keybuttons making up at least a portion of the keyboard array, each keybutton's outer surface comprises a different character image formed of one color, surrounded by a shell of another color, the method comprising the steps of:

providing a unitary assembly of two female die groups, said first female die group having said plurality of individual female dies which provide the exterior shape of the plurality of keybuttons and include a void defining said different characters, and said second female die group having a corresponding plurality of individual female dies which accept said exterior shape without obstructing said voids;

mating said first female die group with a first male die group and injection molding said one color to thereby form a said one-color shell of all of said plurality of keybuttons, each of which includes a void in the shape of that keybutton's character;

separating said first female die group from said first male die group, while leaving said shells of said plurality of keybuttons on said first male die group;

mating said second female die group with said first male die group while said first male die group supports said shells of said plurality of keybuttons;

applying a force between said second female die group and the shells of said plurality of keybuttons, to thereby retain said shells within said second female die group as said first male die group is separated therefrom;

mating said second female die group with a second male die group which is of a smaller size than said first male die group, to thereby define a plurality of cavities between said second male die group and the interior surface of said each of said shells; and

injection molding the plurality of cavities thus formed with material of said another color.

8. The method of claim **7** including the additional step of separating said second female die group from said second male die group as the finished keybuttons are held in said second female die group by operation of said applied force.

9. The method of claim **8** including the step of rotating said unitary assembly between two positions whereat said first and second male die groups are mounted, and including the additional step of providing said force as a vacuum force which extends through a plurality of conduits in said second female die group.

10. The method of claim **9** including the step of mating said second female die group with said second male die group, and mating said first female die group with said second male die group, and thereafter substantially simultaneously molding a plurality of keybutton shells in said first female die group, as the prior-molded plurality of keybutton shells in said second female die group is interior-filled with said another color material.

11. The method of claim **10** including the next subsequent steps of positioning said second female die group generally vertically downward, and ejecting said plurality of finished keybuttons into a carrier, and then transferring said keybuttons to a tray having movable keybutton cavities.

12. The method of claim **11** including the next subsequent step of moving said keybutton cavities into the configuration of a keyboard.

13. The method of claims **7, 8, 9** or **10** wherein the injection into said first and second female die groups is effected through sprues which are formed in a reciprocating mold plate, and including the step of effecting movement of said mold plates to sever the one-color and the another-color sprue runner from the keybutton shells and from the finished keybuttons, respectively.

* * * * *

Oct. 26, 1943. W. R. TUCKER 2,333,059

TWO COLOR INJECTION DIE

Filed Jan. 8, 1941 4 Sheets-Sheet 1

FIG. 1

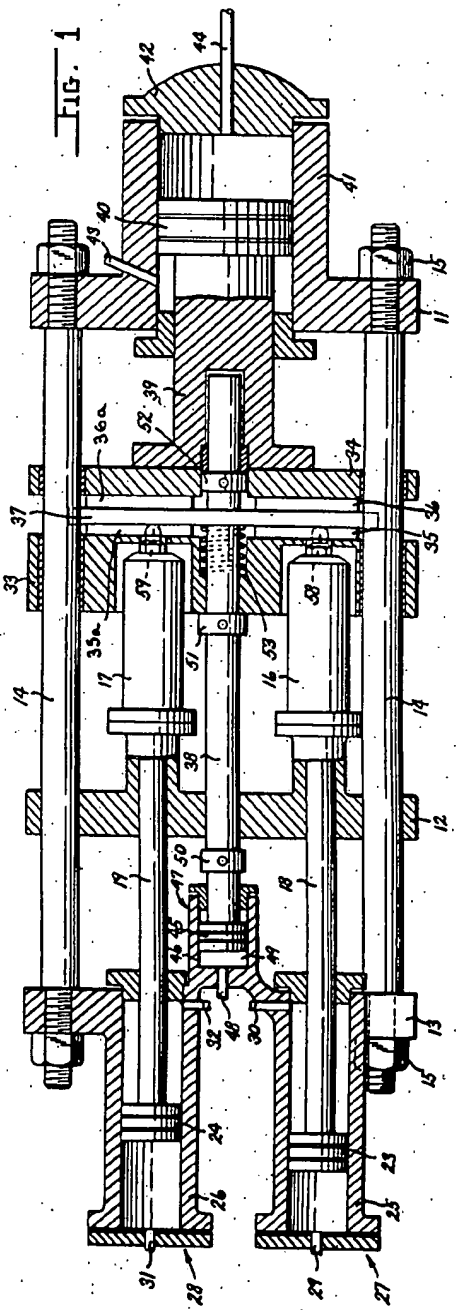
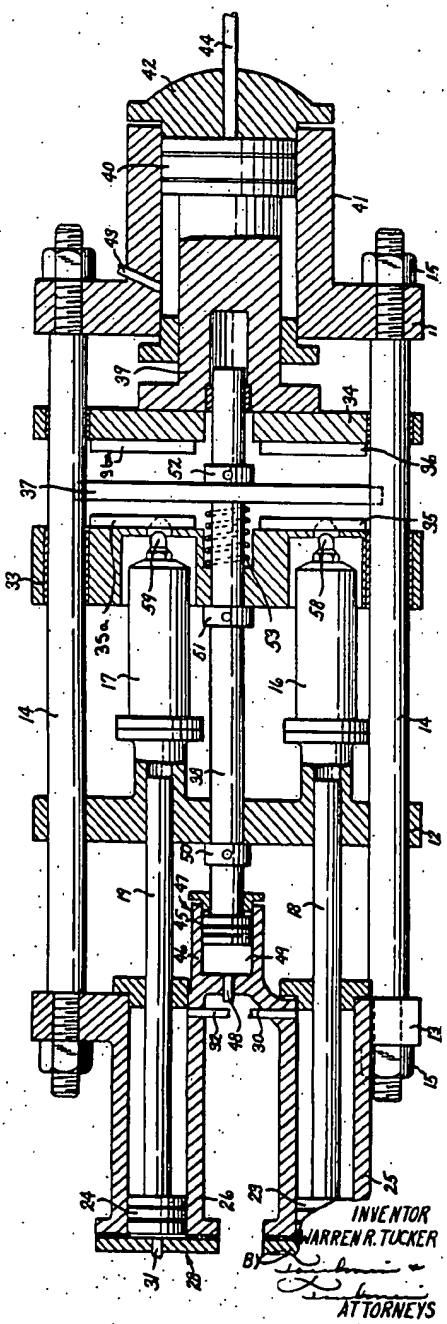


FIG. 2



Oct. 26, 1943. W. R. TUCKER 2,333,059

TWO COLOR INJECTION DIE

Filed Jan. 8, 1941 4 Sheets-Sheet 2

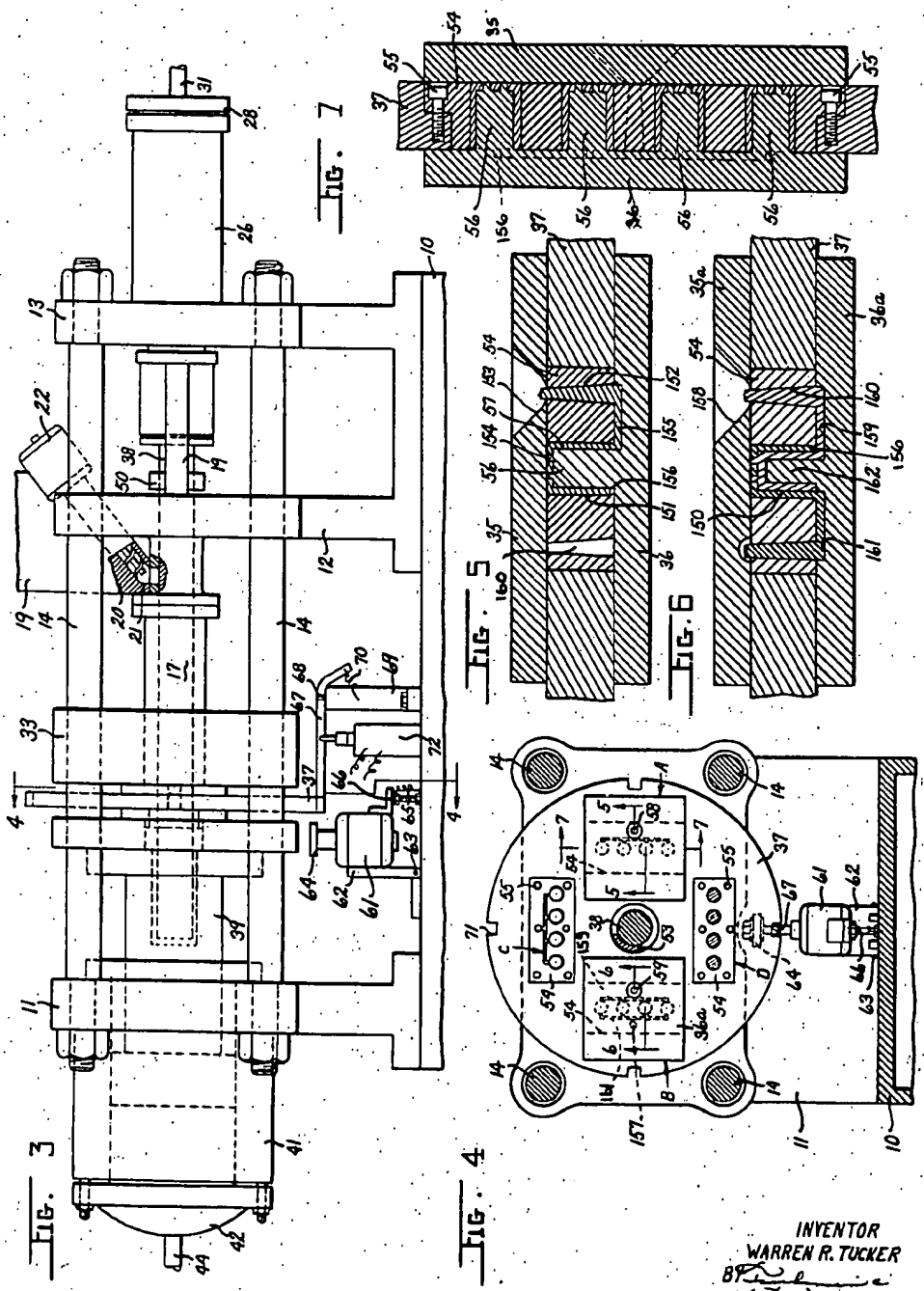


FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

INVENTOR
WARREN R. TUCKER
BY
ATTORNEYS

Oct. 26, 1943. W. R. TUCKER 2,333,059

TWO COLOR INJECTION DIE

Filed Jan. 8, 1941 4 Sheets-Sheet 3

FIG. 8

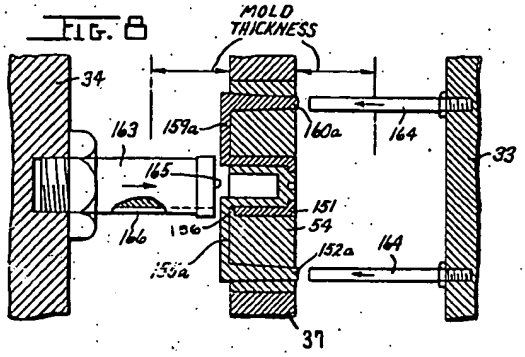


FIG. 10

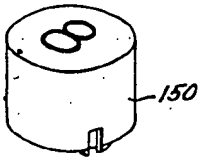


FIG. 9

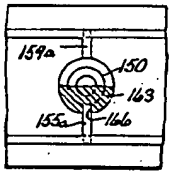


FIG. 11

FIG. 12

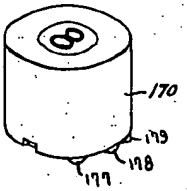
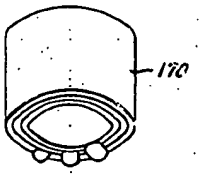


FIG. 16



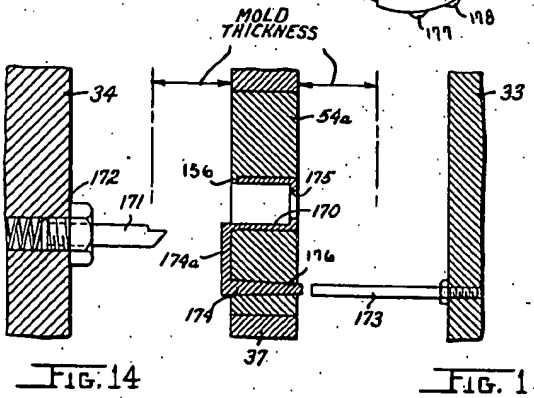


FIG. 13

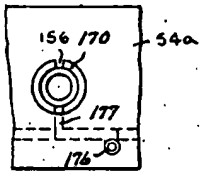


FIG. 14

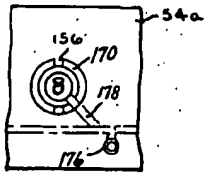
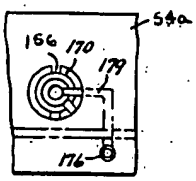


FIG. 15



INVENTOR
WARREN R. TUCKER
BY
ATTORNEYS

Oct. 26, 1943. W. R. TUCKER 2,333,059

TWO COLOR INJECTION DIE

Filed Jan. 8, 1941 4 Sheets-Sheet 4

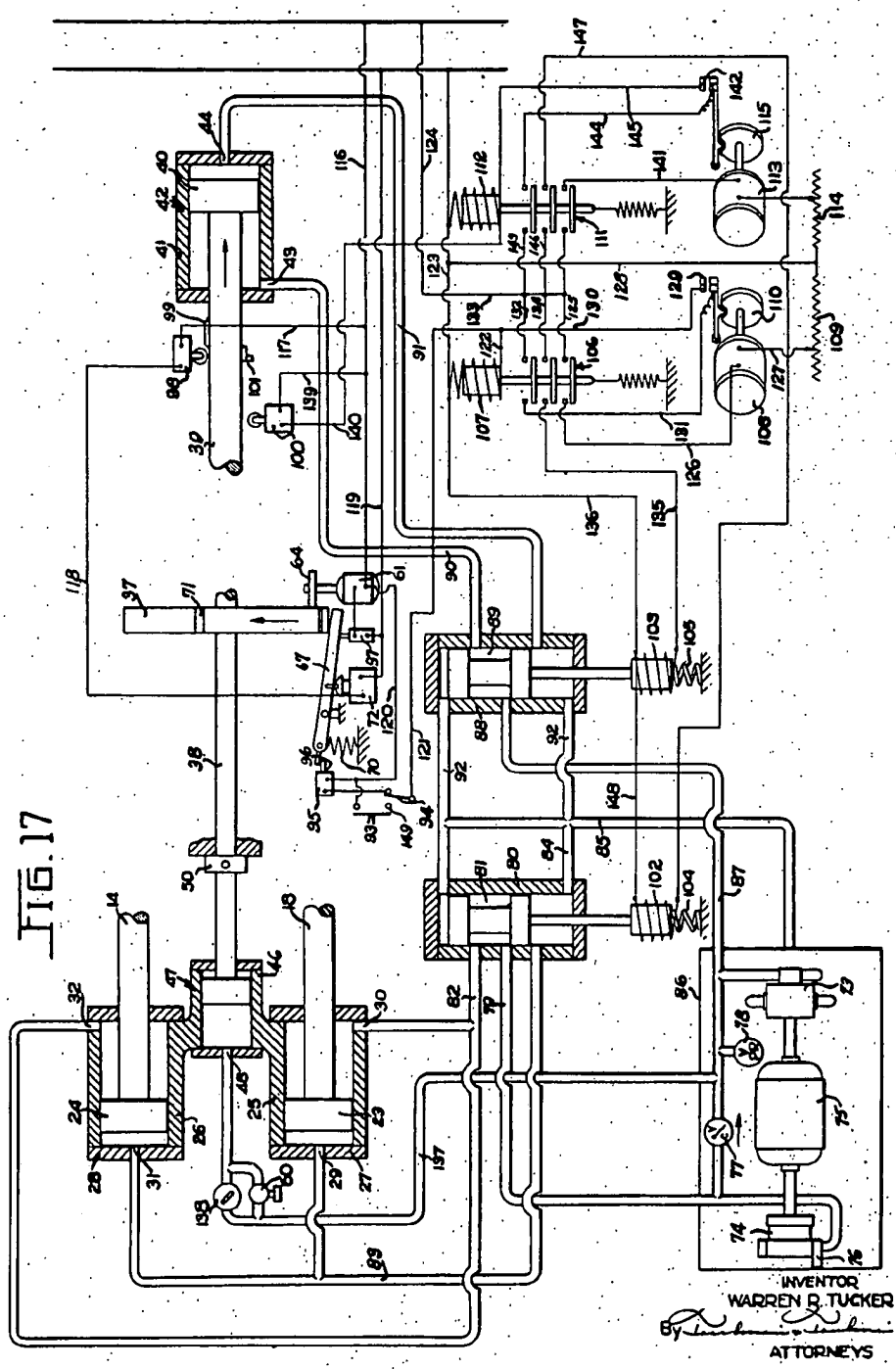


FIG. 17

INVENTOR
WARREN R. TUCKER
By
ATTORNEYS

Patented Oct. 26, 1943 2,333,059

UNITED STATES PATENT OFFICE

2,333,059

TWO COLOR INJECTION DIE

Warren R. Tucker, Dayton, Ohio, assignor to The Hydraulic Development Corp. Inc., Wilmington, Del., a corporation of Delaware

Application January 8, 1941, Serial No. 373,650

15 Claims. (Cl. 18—30)

This invention relates to plastic injection apparatus for producing plastic articles from a plurality of different plastics which may be either of different characteristics or of different colors.

An object of the invention is to provide an apparatus for producing a composite plastic article from a plurality of plastics by a continuous process.

Another object of the invention is to inject plastic material into a forming die by subsequent steps to form a composite plastic article from a plurality of plastics.

It is another object of the invention to provide an apparatus according to the foregoing object wherein the injections of plastic into the forming die are used as a part of the die member for subsequent injections.

It is another object of the invention to provide a plastic injection machine capable of injecting two or more plastics into a common mold cavity to form a composite plastic article.

It is another object of the invention to provide a machine in accordance with the foregoing object wherein the various steps of injection of plastic material into the mold are carried out in a regular order in a continuous process.

It is another object of the invention to provide a plastic injection machine for producing plastic articles from a plurality of plastic materials wherein a common sprue opening can be used for all of the injections of plastic material.

It is still another object of the invention to provide a plastic injection machine wherein the forming molds are carried by a turret for successive advancement into operative relation with various plastic injection stations whereby plastics of different characteristics or colors can be injected into the mold cavity in successive steps to produce a composite article.

It is another object of the invention to provide a plastic injection machine for producing composite plastic articles wherein the sprues and runners are ejected from the mold after each injection and the work piece is retained within the mold so that further work can be accomplished upon the same.

It is another object of the invention to provide a plastic injection machine for producing composite articles wherein the work piece is retained in a mold through a succession of operations.

It is another object of the invention to eject a work piece and the sprue and runners in opposite directions from the mold.

It is another object of the invention to provide a completely automatic plastic injection machine for producing plastic articles from a multiplicity of plastics in a continuous process.

It is another object of the invention to provide a method for producing composite plastic articles from a plurality of plastic materials by a succession of injection operations into a common mold cavity.

It is still another object of the invention to provide a method of producing composite plastic articles by utilizing the material injected into the mold as a part of the mold for subsequent injection operations.

It is another object of the invention to provide an apparatus for removing the sprue and runners from a mold in which plastic material has been injected after the injection operation and retaining the work piece in the mold to permit the sprue and runners to be used again for a subsequent injection of plastic material.

Further objects and advantages will be apparent from the drawings and from the following description.

In the drawings:

Figure 1 is a plan view, partially in cross-section and partially in elevation, of a plastic injection machine for practicing the purposes of this invention, the machine being shown in the injecting position.

Figure 2 is a plan view similar to Figure 1 but shows the machine in the idle position.

Figure 3 is a side elevational view of the machine disclosed in Figure 1.

Figure 4 is a cross-sectional view taken along line 4—4 of Figure 3.

Figure 5 is a horizontal cross-sectional view of the mold taken along line 5—5 of Figure 4, showing the injection of a plastic material.

Figure 6 is a horizontal cross-sectional view of the mold taken along line 6—6 of Figure 4, showing the injection of a second plastic into the same mold.

Figure 7 is a vertical cross-sectional view of the mold taken along line 7—7 of Figure 4.

Figure 8 is a cross-sectional view showing the mechanism for ejecting the work piece and the sprue and runners in opposite directions from the mold.

Figure 9 is a cross-sectional view taken along line 9—9 of Figure 8.

Figure 10 is a perspective view of a work piece produced from two different plastics.

Figure 11 is a perspective view of a work piece produced from three different plastics.

Figure 12 is a perspective view of the bottom edge of the work piece disclosed in Figure 11

showing the manner of arranging the gates around the work piece.

Figures 13, 14 and 15 are plan views of a mold showing the manner in which the runners and gates can be arranged for injecting a plurality of plastics into a common mold from a common sprue.

Figure 16 is a cross-sectional view of a portion of the mechanism of the plastic injection machine, showing the manner in which the sprue and runner can be ejected from the mold without removing the work piece.

Figure 17 is a diagrammatic system view of the hydraulic and electric controls for complete automatic operation of the injection machine of this invention.

In this invention the plastic injection machine consists of a bed 10 upon which there is stationarily mounted the upright 11 at one end of the bed 10, and the uprights 12 and 13 at the opposite end thereof. Strain rods 14 extend between the uprights 11 and 13 and are arranged to space the uprights 11 and 13 with respect each other. Suitable bolts 15 secure the strain rods 14 to the uprights 11 and 13. The strain rods 14 extend through the stationary uprights 12 for providing additional support for the same.

The upright 12 carries a plurality of injection cylinders 16 and 17, in which the injection plungers 18 and 19 operate. As disclosed in the drawings there is shown only two injection cylinders. However, as the description of the machine proceeds it will become apparent that the number of injection cylinders used on the machine is limited only by the space within a given diameter of the machine. It will be hereinafter shown the manner in which any number of injection cylinders can cooperate with the dies or mold for injecting any number of different plastic materials into a common mold cavity by successive injection operations. The injection cylinders 16 and 17 are heated in any well known manner for plasticizing the plastic material fed into the cylinders. The heating means can be either electric, steam, or any other well known heating device, such heating apparatus for injection cylinders being well known in the art and is not therefore particularly disclosed and will not be described with regard any particular heating means.

Each of the injection cylinders 16 and 17 is provided with a means for feeding plastic material into the same. Each of the feeding apparatus is arranged to feed a different material into its respective injection cylinder so that each injection cylinder is fed with a different plastic material from its own source of supply. This feeding means consists of a hopper 19 which is suitably mounted upon the injection cylinder and which is arranged to contain the plastic material to be fed into the cylinder. A feed screw 20 is arranged within the feeding chamber of the hopper 19 for advancing material through the feeding chamber into the inlet opening 21 of the injection cylinder. A suitable electric motor 22 is provided for rotating the feed screw 20 whereby the plastic material will be advanced into the injection cylinder each time the motor 22 is caused to function.

Suitable electric control of the operation of the motor 22 is provided for automatically controlling the quantity of plastic material fed into the injection cylinder in accordance with the quantity of material ejected from the cylinder, such controls being well known in the art and of which the control system disclosed in the patent to Lawyer, No. 2,159,559, is a typical example. As heretofore mentioned each of the injection cylinders 16 and 17, and any other injection cylinders positioned on the machine, are provided with the feeding mechanism heretofore described.

The injection plungers 18 and 19 are connected to the pistons 23 and 24 respectively which operate within the cylinders 25 and 26 respectively. The association of pistons and the cylinders provide hydraulic motors 27 and 28 respectively which are adapted to reciprocate the plungers 18 and 19 within the cylinders 16 and 17 respectively for ejecting plastic material therefrom during a certain portion of the cycle of operation of the plastic injection machine. The hydraulic motor 27 is provided with fluid connections 29 and 30 arranged at opposite ends of the cylinder 25 for admission of fluid to the cylinder 25 and the exhaust and fluid therefrom. Similar connections 31 and 32 are provided on the cylinder 26 for the hydraulic motor 28. Suitable controls hereinafter described are provided for controlling the admission of the hydraulic fluid to the respective fluid connections for reciprocating the pistons 23 and 24 within their respective hydraulic motors.

Bolsters 33 and 34 are carried upon the strain rods 14 in a manner that they can slide longitudinally thereupon. The bolster 33 carries a die closure plate 35 while the bolster 34 carries a die closure plate 36. A turret 37 is arranged between the die closure plates 35 and 36 and is rotatably supported upon the shaft 38.

The bolster 34 is connected to the ram 39, which ram has an enlarged head to form a piston 40 which is arranged for reciprocation within a cylinder 41 thereby providing a hydraulic motor 42. Suitable fluid connections 43 and 44 are provided for the cylinder 41 at opposite ends thereof for reciprocating the piston 40 therein, whereby the ram 39 is reciprocated for closing and clamping the end closure plates 35 and 36 in a manner which will be hereinafter described.

The turret 37, as previously mentioned, is carried upon the rod 38 the turret being both rotatable and slidable upon the shaft 38. The shaft 38 extends through the stationary upright 12, the bolsters 33 and 34 and into the ram 39. One end of the rod 38 is provided with a piston head 45 which is associated with a cylinder 46 and is arranged for reciprocation therein, whereby a hydraulic motor 47 is provided for reciprocating the rod 38 for purposes which will be hereinafter described. A fluid connection 48 is provided in one end of the cylinder 46 for establishing pressure in the chamber 49. Stop collars 50, 51 and 52 are secured upon the rod 38 in such a manner that they cooperate with the upright 12, the bolster 33 and the turret 37 to control movements of the rod 38, the bolster 33 and the turret 37. A spring 53 is positioned between the turret 37 and the bolster 33 for urging the turret 37 away from the bolster 33 when the end closure plates 35 and 36 are separated by the hydraulic motor 42.

The turret 37 in cooperation with the die closure plates 35 and 36 provides a mold in which plastic material can be injected. Preferably the turret is provided with die inserts which may be suitably secured within the turret 37 by means of the bolts or screws 55. The die inserts 54 are provided with suitable cavities which form the configuration of the article to be formed therein. The die closure plates 35 and 36 are provided

with core members 56 which cooperate with the die cavities 57 in the die inserts 54 for producing a cavity of a suitable shape within which plastic material can be injected to form an article of predetermined configuration. It is thus seen that the mold for producing the plastic article consists of three elements rather than the usual two. The die closure plates 35 and 36 are stationary with respect the turret 37, the turret being rotated between the die closure plates in a manner to advance the mold cavity adjacent the injection cylinders 16 and 17 upon subsequent operations of the injection machine.

The mechanism of the machine heretofore described is arranged for closing the molds, advancing the molds into engagement with the injection nozzles of the injection cylinders, of applying clamping pressure upon the molds and of injecting material into the molds. This cycle of operation will be understood by those versed in the plastic injection art but will be described with particularity with regard the machine of this invention. Referring to Figure 2, the machine is shown in the idle position. In order to place the machine in condition for injection of plastic material into the die cavities 57 hydraulic fluid is admitted through the fluid connection 44 in the motor 42 whereby the piston 40 is forced forwardly. Forward movement of the piston 40 carries the ram 39 and the bolster plate 34 forward until it engages the turret 37. Continued forward advancement of the ram 39 causes the turret 37 to compress the spring 53 to permit engagement of the turret 37 with the die closure plate 35, whereby the bolster 33 is moved toward the injection cylinders 16 and 17 to cause engagement of the injection nozzles 58 and 59 respectively with the die closure plate 35.

In order to relieve the force of engagement of the die closure plate 35 upon the injection nozzles 58 and 59, hydraulic fluid has been admitted to the motor 47 through the fluid connection 48 which has a choke valve 60, see Figure 17, positioned therein to retard the outward flow of fluid from the chamber 49. Compression of the fluid in the chamber 49 will thus absorb or cushion the engagement of the die closure plate 35 upon the injection nozzles 58 and 59.

After the ram 39 has closed the mold and engaged the same with the injection nozzles, hydraulic fluid is admitted to the motors 27 and 28 through the connections 29 and 31. The pistons 23 and 24 are then forced forwardly carrying the injection plungers 18 and 19 through an injection stroke within the cylinders 16 and 17. Plastic material is thereby forced through the nozzles 58 and 59 into the die cavities 57. As disclosed in the drawings both of the injection plungers 18 and 19 operate substantially simultaneously so that the injection of the plastic materials retained within the various injection cylinders will occur through the same time interval of the cycle of operation of the machine.

At this point in the cycle of the operation of the machine, the position of the various apparatus is as disclosed in Figure 1. After a suitable dwell period for permitting the plastic material in the various molds to set, the injection plungers 18 and 19 are retracted from the cylinders 16 and 17 by the admission of fluid to the motors 27 and 28 through the fluid connections 30 and 32 respectively. Upon reciprocation of the plungers 18 and 19 the mechanism for feeding plastic material from the hopper 19 is set in motion and is operated for a predetermined time interval to feed a determined quantity of material into the injection cylinder, such operation being heretofore referred to and is described in detail in the aforementioned Lawyer patent.

When the plungers are on their retraction stroke the ram 39 can be retracted by the motor 42 since hydraulic fluid will now be admitted to the motor 42 through the fluid connection 43. As the ram 39 moves in a rightward direction, see Figure 1, the bolsters 33 and 34, with the mold, comprising the end closure plates 35, 36 and the turret 37, will move as a unit to disengage the end closure plate 35 from the injection nozzles 58 and 59, such movement being caused by pressure within the chamber 49 of the motor 47. The bolster 33 and the cooperating mechanism will be moved in a rightward direction until the stop collar 50 strikes the upright 12, at which time the bolster 33 will stop. However, the ram 39 continues its retraction motion thereby removing the die closure plate 36 away from the die closure plate 35. In this motion the spring 53 will move the turret 37 away from the end closure plate 35 until the turret 37 strikes the stop collar 52. The ram 39 still continues its retraction motion until the piston 40 bottoms in the cylinder 41, whereby the apparatus will now be positioned as disclosed in Figure 2 and is again ready for a subsequent injection cycle after the turret 37 has been indexed in order to present the mold which was in operative alignment with the injection cylinder 16 into operative alignment with the injection cylinder 17.

The indexing mechanism for the turret 37 consists of an electric motor 61 carried upon an arm 62 which is pivoted at 63 upon the base 10. A friction wheel 64 is carried by the shaft of the electric motor 61 and is arranged to engage the turret 37 to rotate the same by frictional engagement therewith. The motor 61 is carried on the arm 62 on one side of the pivot 63 so that the weight of the motor causes frictional engagement of the friction wheel 64 against the turret 37. This frictional engagement can be aided by a spring 65. A stop member 66 is provided adjacent the motor 61 to prevent the same from pivoting too far in a forward direction when the turret 37 is retracted to the position disclosed in Figure 2.

A turret lock is provided for securing the same in an indexed position and consists of a locking arm 67 which is pivoted at 68 upon an upright 69, and is urged in an upward direction about the pivot 68 by means of a spring 70, whereby the arm 67 will engage the locking slots 71 provided in the turret 37 upon the slots aligning with the arm 67. To release the arm 67 from the locking slots 71 an electric solenoid 72 is provided which is suitably connected to the arm 67. Energization of the solenoid 72 will cause the arm 67 to be disengaged from the slot 71 thereby releasing the turret 37 to permit rotation thereof by the electric motor 61.

The hydraulic system and the electrical controls for the injection machine, and the automatic operation thereof will now be described. The hydraulic system for operating the injection machine consists of a variable delivery high pressure pump 73, and a constant delivery low pressure pump 74 which are connected to a common electric motor 75. The variable delivery pump 73 is provided with conventional control mechanism for controlling the maximum pressure of delivery from the pump, which high pres-

sure of delivery is used for clamping the molds during the injection cycle of the machine. The controls for regulating such a variable delivery pump are well known, and the pump need not be of any particular variety and therefore further description of the exact pump nature is not believed necessary. The low pressure constant delivery pump 74 is provided with a relief valve 76, which valve is provided to permit by-passing of the output of the pump 74 when the pressure in the system is above the maximum delivery pressure of the constant delivery pump. A check valve 77 is provided in the common discharge line between the pumps 74 and 73 to prevent the high pressure of the pump 73 from reacting upon the pump 74 during certain portions of the cycle of operation of the injection machine. A safety pressure relief valve 78 is provided in the discharge conduit from the pump 73 to prevent development of undue pressures should the control mechanism of the variable delivery pump fail to function.

The constant delivery pump 74 discharges into a conduit 79 which connects with the central chamber of a four-way valve 80. The central chamber 81 of the four-way valve 80 is provided with a conduit 82 which connects with the fluid connections 30 and 32 of the hydraulic motors 27 and 28 respectively. As shown in Figure 17, hydraulic fluid is now present in the motors 27 and 28 to cause retraction of the pistons 23 and 24 respectively. Fluid from the left-hand end of the motors 27 and 28 has been discharged through the fluid connections 29 and 31 respectively into the conduit 83 which is connected to the four-way valve 80 and thus to the return conduit 84 which communicates with a conduit 85 in communication with a fluid storage tank 86. The variable delivery high pressure pump 73 discharges into a conduit 87 which connects with the central chamber of a four-way valve 88. As shown in Figure 17 the central chamber 89 of the four-way valve 88 is connected by means of a conduit 90 with the fluid connection 43 of the hydraulic motor 42, whereby the motor is being retracted by the admission of fluid thereto. The fluid in the right-hand end of the hydraulic motor 42 is discharged through the fluid connection 44 into a conduit 91 which is also connected with the valve 88 for directing the flow of fluid through the conduit 92 to the fluid return conduit 85 of the storage tank 86. When the valves 80 and 88 are shifted to their opposite positions from that shown in Figure 17 the conduit 92 communicates with the conduits 82 and 90 respectively for return flow of hydraulic fluid from the hydraulic motors 27, 28 and 42, fluid under pressure then being admitted through the conduits 91 and 83 for forward advancement of the pistons 23, 24 and 40 within the respective motors.

The electric circuit for the injection machine consists of a manually operated push button switch 93. A selector switch 94 is provided for establishing whether the machine shall operate completely automatically or whether the machine shall operate through one cycle of operation and then stop, subsequent operations being manually started by operation of the push button switch 93. An electric switch 95 is operated by means of the arm 67 of the indexing mechanism for the turret 37. This switch is of a type which is normally open and will be closed only upon a downward movement of the lever 96. The switch 95 is so arranged that when the arm 67 strikes the lever 96 tending to move the same in an upward direction the switch 95 will not close circuit therethrough. A normally open switch 97 is in perative association with the arm 67 of the indexing mechanism and is adapted to be closed when the arm 67 engages the same.

A normally open switch 98 is associated with the ram 39 and is adapted to be closed by a projection 99 extending from the ram 39 only when the projection strikes the operating lever of the switch 98 moving in a right-hand direction. This switch 98 controls the initiation of an indexing cycle which will be hereinafter described.

A normally open electric switch 100 is also associated with the ram 39 and is adapted to be closed momentarily when the projection 101 strikes the operating lever thereof when moving in a leftward direction. The switch 100 is arranged to prevent the closure of electric circuit when the operating lever is carried in a rightward direction. This switch is associated with the ram in such a manner that it is tripped at the proper position of mold closing to initiate operation of the injection plunger as will be hereinafter described. The four-way valves 80 and 88 are electrically controlled by means of the solenoids 102 and 103 respectively, the springs 104 and 105 urging the valves 80 and 88 respectively into their positions as shown in Figure 17.

An electric relay 106 having an operating solenoid 107 controls the current to a timing motor 108. The timing motor 108 is provided with a rheostat 109 in the electric circuit thereof to control the speed of operation and thus control the duration of the time interval for rotation of the cam 110. This mechanism controls the timing cycle for the mold closing apparatus.

An electric relay 111 operated by a solenoid 112 controls the electric circuit to a timing motor. The timing motor 113 is provided with a rheostat 114 in the electric circuit thereof for controlling the operation of the motor and thus the time interval for rotating the cam 115. This mechanism controls the timing cycle of the injection plungers 18 and 19.

Referring to Figure 17, the cycle of operation of the machine is as follows. The position of the elements of the control system and the elements of the machine are such that the injection plungers 18 and 19 have been retracted from their respective cylinders 16 and 17. The ram 39 is retracted so that the die closure plates 35 and 36 are in the open position as shown in Figure 2, and the turret 37 is released, as disclosed in Figure 2. Upon retraction of the ram 39 the projection 99 thereon engages the switch 98 to close circuit therethrough by means of the electric lines 116, 117 and 118 to the solenoid 72, the return circuit being through the line 119. The solenoid 72 is thus energized retracting the arm 67 from within the slot 71 of the turret 37. When the arm 67 is retracted the electric switch 97 is engaged thereby, whereby circuit is completed to the electric motor 61 through the line 116, the electric switch 97 and the return line 119. The electric motor is now driving the turret 37 to index the same to the next position, or until the arm 67 engages the next successive slot 71. Indexing of the turret 71 positions the mold cavities 57 in their proper positions with respect the injection nozzles 58 and 59 for subsequent injection operations, which operations will be hereinafter described.

When the turret 37 has been rotated a sufficient distance, or a quarter turn, as indicated by the disclosure of this invention, the arm 67

will engage the slot 71, being forced into the slot by the tension spring 70. Downward movement of the arm 67 causes the end thereof to engage the operating lever of the switch 95, whereby electric circuit is momentarily made through the lines 118 and 120 to the switch 95, through the switch 95, the line 121, 122 to the solenoid 107, return circuit being made through the line 123. Momentary closure of this circuit energized the solenoid 107 to close the relay 106.

When the relay 106 is closed electric circuit is made for the timing motor 108 through the lines 124, 125 and 126, the return circuit being through the line 127, the rheostate 109 and the line 128. The electric motor 108 is thus initiated in operation whereby the cam 110 rotates to close the contacts 129 thereby establishing a holding circuit for the solenoid 107 through the line 123, the solenoid 107, the lines 122 and 130, the contacts 129 and the lines 131, 132 and 133. The timing motor 108 is adapted to revolve the cam 110 one full revolution to maintain the solenoid 103 energized through a circuit established through the lines 133, 134 and 135 to the solenoid 103, the return circuit being through the lines 136 and 123. Energization of the solenoid 103 shifts the four-way valve 88 to a position whereby hydraulic fluid is delivered through the lines 87 and 91 to the right-hand end of the hydraulic motor 42. A return circuit for hydraulic fluid is now established through the lines 90, 92 and 86.

The forward advancement of the ram 39 is only lightly resisted during the first part of its movement so that the full volume of the low pressure pump 74 and of the high pressure pump 73 is delivered to the hydraulic motor 42. The ram 39 first causes the die closure plate 36 to engage the turret 37 and advance the same into engagement with the die closure plate 35. Continued advancement of the ram 39 advances the bolster 33 into engagement with the injection nozzles 58 and 59. During the time the ram 39 is moving forwardly fluid pressure is established in the conduit 137, through the check valve 138 to the hydraulic motor 47.

The fluid pressure in the hydraulic motor 47 retains the turrent 37 and the bolster 33 in the positions as shown in Figure 1. As soon as the ram 39 engages the turret 37 tending to close the same against the die closure plate 35, the fluid within the motor 47 will be forced out of the motor 47 through the choke valve 60, the check valve 138 being closed against return flow of fluid. A resistance is thus established to prevent the ram 39 from forcibly engaging the bolster 33 with the injection nozzles 58 and 59. Once the nozzles are engaged the position of the elements is as disclosed in Figure 1, whereby the variable delivery high pressure pump 73 increases the fluid pressure in the motor 42 to its maximum pressure to establish the desired mold closing pressure. The check valve 77 is closed at this time by the high pressure fluid acting thereon.

As the ram 39 moves forwardly the projection 101 secured thereon trips the electric switch 100 near the end of the mold clamping stroke whereby electric circuit is established to the solenoid 112 through the lines 116 and 139 to the switch 100, through the line 140 to the solenond 112, the line 123 establishing the return circuit. The momentary tripping of the switch 100 energizes the solenoid 112 to close the relay 111 to establish electric circuit to the timing motor 113 by means of the electric circuit through the lines 133 and 141 to the motor 113 through the return circuit made by the rheostat 114 and the lines 128 and 123. The timing motor 113 thus starts to rotate the cam 115 whereby the contacts 142 are closed establishing a holding circuit for the relay 111 through the lines 124, 133, 143 and 144 to the contacts 142 and a return circuit through the line 145, the solenoid 112 and the line 123. The closing of the relay 111 by the solenoid 112 also establishes a circuit through the lines 124, 146 and 147 to the solenoid 102 and a return circuit through the lines 148, 136 and 123.

Since the hydraulic motor 42 has now clamped the molds in their closed position against the injection nozzles it can be seen that the machine is ready for the injection stroke. The energization of the solenoid 102 shifts the four-way valve 80 to establish fluid pressure within the lines 79 and 83 to the left-hand end of the hydraulic motors 27 and 28, the return fluid circuit being established through the lines 82 and 85. The constant delivery pump 74 will thus advance the injection plungers 18 and 19 to eject plastic material from the injection cylinders 16 and 17, the ejection from the cylinders being substantially simultaneous.

The timing motors 108 and 113 are suitably controlled through the rheostats 109 and 114 to determine the interval of time through which the cycle is operated, the timing motor 113 thus establishing the period of forward advancement of the plungers 18 and 19 and the dwell period thereof, while the motor 108 controls the period through which the molds will be clamped.

After the predetermined dwell period of the injection plungers 18 and 19, as established by the timing motor 113, electric circuit through the contacts 142 is broken thereby deenergizing the solenoid 102 and permitting the spring 104 to shift the valve 80 to the position as shown in Figure 17. The positioning of the valve in this manner re-establishes the hydraulic circuit as disclosed in Figure 17 for retracting the plungers 18 and 19 from the injection cylinders 16 and 17. As the plungers 18 and 19 are retracted, the motor 22 for feeding plastic material into the injection cylinders is started by a suitable control and is automatically controlled in its time cycle to feed a determined quantity of plastic material into the injection cylinders, which controls have heretofore been mentioned as old in the art and which are commonly used for determining the quantity of granular plastic material fed into the injection cylinders. Upon initiation of retraction of the injection plungers 18 and 19 the timing motor 108 completes its timing cycle so that the electric circuit established through the contacts 129 is now broken to deenergize the solenoid 107 and thus the solenoid 103 since the relay 106 will now be open.

Deenergization of the solenoid 103 establishes hydraulic circuit as disclosed in Figure 17 through the valve 88 to cause retraction of the ram 39. Retraction of the ram 39 produces the sequence of events of retracting the bolster 33, the die closure plates 35 and 36 and the turret 37 as a unit from the injection nozzles 58 and 59, spacing of the turret 37 from the die closure plate 35 and causes removal of the die closure plate 36 from the turret 37 as heretofore described. The turret is now released and can be indexed to index the molds a quarter turn. Upon retraction of the ram 39 the electric switch 98 is again closed to establish circuit to the solenoid 72 and initiate the cycle as heretofore described.

The plastic injection machine can either be operated on a full automatic cycle or upon a single cycle of operation as determined by the position of the hand switch 94. When the switch 94 is in the position, as shown in Figure 17, the injection machine will perform on a completely automatic cycle of operation. When the switch 94 is shifted to engage the contact 149 the automatic cycle of operation of the machine will be interrupted after the indexing of the turret 37 since the closure of the switch 95 will now be ineffective to energize the solenoid 107 until the push button switch 93 is manually operated.

The plastic injection machine as heretofore described, and the cycle of operation for the same is particularly adaptable to the injection molding of articles from a plurality of plastic materials for producing composite articles in a continuous process by a plurality of injections into a common mold cavity. It is of course understood that each of the injection cyclinders 16 and 17 are fed by separate feeding mechanisms, each cylinder ejecting a plastic having a different composition or a different color. Since the injection plungers 18 and 19 operate in parallel it can be seen that the machine will inject all of the various plastic materials into their respective mold cavities at the same time and that the turret 37 can be suitably indexed to bring the mold cavity from one injection cylinder to the other for subsequent injections of plastic material.

As heretofore described the mold in which the plastic article is to be produced consists of the die closure plates 35 and 36, one of which is mounted upon the bolster 35 and the other of which is mounted upon the bolster 34. The turret 37 is provided with die inserts 54 which cooperate with the die closure plates 35 and 36 to form a complete mold into which plastic material can be injected.

As disclosed in the drawings of Figures 1 to 10 inclusive, the machine is adapted to manufacture a two-color article such as disclosed in Figure 10 wherein the article 150 consists of a body having a numeral inserted in the top thereof which is of a different color or of a different plastic than the main portion of the body. The apparatus of Figures 1 to 10 discloses the machine as set up for producing this particular article 150.

To produce the article 150 the die inserts 54 are provided with a plurality of circular openings 151 which will form the outer dimension for the button or key 150. A sprue opening 152 is provided in the die insert 54 which communicates with a tapered opening in the die closure plate 35. The tapered opening 153 provides the seat for the injection nozzles 58 and 59 when the die closure plate is brought into engagement with the respective nozzles.

The die closure plate 36 is provided with a core member 56 which is of slightly smaller size than the circular openings 151 in the die inserts 54 thereby establishing a cavity into which plastic material can be injected. The core member 56 is provided with an upwardly extending projection 154 which engages the die closure plate 35 when the elements are in position for injection molding. This projection 154 is according to the disclosure of this invention arranged in the shape of a numeral which can be the numeral eight as disclosed in Figure 10. The die closure plate 36 is also provided with a plurality of grooves 155 which provide the runners and gates for the mold cavity. The turret 37 is provided with a plurality of the die inserts 54, each of which is alike, and which will be indexed adjacent the injection molding stations A and B respectively, see Figure 4. In the cycle of operation of producing the article 150, station A is the first injection of plastic material into the mold cavity while station B is the second injection of material into the mold cavity. The station C can be an injection station for plastic material as will be hereinafter described, or can be a station for ejecting the sprue and runners injected in the station A. The station D is the ejecting station for the completed work piece.

The assembled elements of the mold, as disclosed in Figure 5, are the elements as they will be positioned in the injection station A for the first injection of plastic material into the mold cavity produced by the assembly of elements and the core member 56. The injection machine is placed through its injection cycle for injecting plastic material into the mold cavity 57 whereby the mold will appear as disclosed in Figure 5 with the cavity 57 filled with material.

After the injection operation the die closure plate 36 will be retracted from the turret and the die closure plate 35, thus withdrawing the core 56 from within the die cavity 57. The removal of the core 56 would, under normal circumstances, have a tendency to remove the article molded in the cavity 57. However, this removal is prevented since a small lip 156 is provided in the edge of the circular opening 151 which engages the plastic material in the cavity 57 thereby preventing the plastic article from being forcibly removed from the mold cavity when the core member 56 is pulled from the mold by movement of the bolster 36.

The injection machine will then index the turret to the station C, at which station the injected article can have further work performed thereon, such as a subsequent injection or an ejection of the sprue and runners, which operations and the purposes of the same will be hereinafter described. However, for the purposes of manufacturing the two-color button or key 150 the station C need not be used.

The next indexing of the turret 37 will bring the article which was injected in the station A into the station B. As will be seen in Figure 4, the injection nozzles 58 and 59 are not arranged on the center line of the die but rather are off center so that the sprue opening and runners which were injected in the station A will assume the position indicated at 157 when the mold has been indexed to this point. This arrangement permits one plastic material to be injected in one side of the die cavity 57, while the second material can be injected from the opposite side without requiring the runners of the new material from engaging the runners previously injected, it being understood that the sprue and the runners are in the die closure plate 36a which is associated with the injection station B.

The injection station B has a die closure plate 35a which is similar to the die closure plate 35, wherein the tapered opening 158 is provided for seating the nozzle 59. The die closure plate 36a, which is associated with station B, is provided with the runners 159 through which the second plastic material will be injected, these runners cooperate with the sprue opening 160 which has previously been provided in the die insert 54 for cooperation with the runners 159 when in the injection station B, but is inactive when in the injection station A. The die closure plate 36a is also provided with suitable grooves 161 for re-

ceiving the runners which have been injected at the station A. A core 162 extends from the die closure plate 36a and is of smaller diameter than the cavity provided within the molded work piece as presented in station B, whereby a mold cavity is formed between the core 162 and the work piece 150. It will thus be seen that the work piece 150, as injected at the station A, forms a part of the mold cavity at the station B, the changing of the core members altering the configuration of the die cavity to an extent that a second plastic material can be injected into the article as formed in the first injection station to produce a composite article from a plurality of plastic materials.

After the machine has closed the dies and clamped the same the injection operation as heretofore described is completed, whereby plastic material is injected through the sprue opening 160, the runners 159 and into the newly formed mold cavity. Since the core member 162 is not provided with the same projections 154 as the core member 156 it can be seen that the plastic material injected in the die cavity provided in the injection station B will fill the openings previously provided in the injection station A so that the numeral eight, as disclosed in Figure 10, will appear upon the surface of the button key 150.

As previously mentioned the molded article 150 is retained within the circular opening 151 of the die insert 154 by means of the lip 156. Thus it will be seen that with the lip 156 extending into the molded article that the same will be locked in the die insert 54 by means of the runners formed when the article was injection molded. It will thus be apparent that the article cannot be ejected from the mold in the common manner of merely inserting ejecting pins at proper locations for ejecting the molded article, the runners, sprues and gates as a unit piece. In this invention therefore means are provided for clipping the gates of the molded article and for ejecting the molded article in a direction opposite from that which the sprue and runners will be ejected. This mechanism is disclosed in Figures 8 and 9.

The clamping bolster 34 is provided with a plurality of ejecting pins which are suitably secured thereto and which are associated with the station D, as indicated in Figure 4, station D being the ejecting station for the work piece and for clearing the molds. The bolster 33 is also provided with a plurality of ejecting pins 164, which ejecting pins are positioned in a manner to engage the sprues 152a and 160a. The face 165 of the ejecting pin 163 provides an edge around the periphery thereof which engages the runners 159 and 155 in a manner to cut the runners from the work piece 150. The pins 163 can then eject the work piece 150 from the circular opening 151 of the die inserts 54 in the direction toward the bolster 33 while the epecting pins 164 eject the sprues 160a and 152a with the runners 159a and 155a respectively in the direction of the bolster 34. The ejecting pins 163 have a groove 166 in the edge thereof arranged to pass over the lip 156 provided in the inserts 54 whereby the ejecting pins can pass through the insert 54.

The ejecting operation takes place at station D, see Figure 4, upon the closing or clamping motion of the die closure plates 35 and 36 by means of the bolsters 33 and 34 respectively. It is thus seen that this invention provides means for locking the work piece in place in the die inserts for removal and insertion of various core members to form die cavities of different configuration so that the work piece can be progressively indexed adjacent successive injection stations to produce a composite plastic article from a plurality of plastic materials, the work piece remaining with the mold through the entire process of the several injection operations.

While the apparatus as heretofore described has been directed to the manufacture of a two-color plastic article, or an article made from two different plastics, the machine and the process is just as applicable to the injection of any number of plastic materials. It is required that but slight modification be made of the apparatus in order to inject any number of materials by subsequent injection steps into a common mold cavity.

In order to utilize the machine as disclosed in Figures 1 to 10 inclusive for the injection of more than two plastic materials it is only required that a third injection cylinder be stationed adjacent the station C, see Figure 4, and position the injection nozzle in such a manner that the sprue entering the mold will not interfere with the sprues of the stations A and B. The runners and gates for the mold can very easily run under or over the runners previously injected without danger of mixing either plastics of different composition or of different color. It is thus seen that in order to inject more than two colors it becomes a matter of mold and runner design for the various mold cavities rather than any specific alteration of the machine other than the addition of sufficient injection cylinders to take care of the number of different plastic materials which are to be injected.

In Figures 12 to 15 inclusive there is shown a modified arrangement for injection molding an article having three different colors, or it can be made from plastic materials having three different compositions. In the arrangement disclosed therein, the runners and the sprues are clipped and ejected after each injection operation so that the same sprue opening can be used for a subsequent injection operation, it being necessary only to change the gates and the runners but slightly in order to provide a second access opening into the mold cavity.

In this modification the molded article 170 consists of a body of one color having a numeral inserted in a circle of a third color. In the arrangement herein disclosed the die closure plates and the association thereof with the turret is the same as in the machine described in the general description. The functioning of the machine and the general method of inserting the core members into the dies for altering the configuration of the die cavity and the utilization of the previously injected plastic material as a part of the die is the same association of parts and functions as heretofore described. In the modified form of apparatus however the sprue and runners are adapted to be ejected from the mold immediately after the injection thereof. This operation can be performed simultaneous with opening of the dies after the injection operation, and before the turret is indexed, or can be arranged as a separate step between the injection stations. It will be understood by those versed in the art as to the manner in which such ejection mechanisms can be constructed for the aforementioned purpose. However, to disclose

at least ne apparatus whereby the above mentioned function can be performed, Figure 16 discloses the ejecting mechanisms as associated with the bolster 36 and the bolster 33. In the arrangement herein disclosed the clamp bolster 34 carries a cutting device 171 which is reciprocably mounted with respect the bolster 34, and is spring loaded by means of a spring 172. The bolster 33 carries an ejecting pin 173 which is in proper alignment with the sprue 174.

It is to be understood that the molded article 170 has just passed through the first stage of injection in the station A wherein the preliminary shell for the molded article 170 has been injection molded. A suitable core was inserted therein in order to permit the top opening 175 to remain unfilled until a subsequent injection operation. Upon the movement of the bolster 34 toward the turret 37 of the cutting device 171 strikes the runner 174a thereby severing the same from the body of the molded article 170. Immediately after severance of the runner 174a the ejector pin 173 strikes the sprue 174 and ejects the runner from the mold. The cutter 171 retracts into the bolster 34 when the same closes upon the turret 37 to clamp against the bolster 33. While the operation has been heretofore set forth as an independent operation which is performed between injection stations, since the ejecting of the sprue occurs simultaneously with mold closing, it will be readily understood by those versed in the art that the mechanical arrangement of the ejecting mechanisms can be such as to produce the ejection upon the mold opening operation and thus perform the sprue ejection immediately after the injection operation.

Since the sprue and runners has been ejected from the die insert 54a it can readily be seen that when the die insert is indexed by the turret 37 to the next injection station that the same sprue opening can be used as well as at least a portion of the runner. It is only required that new gates be provided to the newly formed mold cavity as provided by the proper association of core members with the molded article 170. As disclosed in Figures 13, 14 and 15, the sprue opening 176 remains in the same position with respect the mold cavity for the various injection operations. The only change required for permitting the second and third materials to enter the mold cavity is the alteration of the runners and the gate for the mold. The runner 177 of Figure 13 is arranged for the injection of the first plastic material, while the runner 178 shown in Figure 14 is provided with a new gate entrance into the mold cavity for the injection of the second material, and the runner 179 of Figure 15 is a new runner, yet it will be seen that the sprue opening 176 has remained in the same position.

The arrangement of the apparatus as disclosed in Figures 13 to 16 inclusive permits a much less complicated runner and gate arrangement when injecting more than two colors or two plastic materials since in a multiple mold the number of runners is of a considerable number, and if all of the runners and sprues are permitted to remain in the mold throughout the entire process of injection molding the composite article it can readily be seen that considerable complications will arise as to the positioning of the various sprues, runners and gates. Also, it can readily be seen that by the removal of the sprues and runners, as herein provided, the number of colors which can be injection molded into a common mold cavity is limited only by the number of gates which can be positioned around the mold cavity. Therefore, the apparatus is universal for injection molding any composite article from a plurality of plastics, it being required merely that the machine have sufficient injection cylinders carrying different materials or different colored materials for injection molding the desired number of materials.

While the form of the apparatus herein described constitutes a preferred form, yet it can readily be seen that various mechanical arrangements can be provided for performing the functions of my invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An apparatus for injection molding multiplastic articles comprising a mold having opposite open faces and chambers therein to form mold cavities, means engaging said mold faces to close said chambers and form a mold cavity, core means movable into and out of said mold, means for injecting plastic material in a cavity of said mold to form a semi-complete article having a runner extending therefrom, means in said mold for preventing movement of the semi-completed article in one direction in the mold when the mold is open for withdrawal of said core means, means in the mold in which the runner is formed when the semi-completed article is injection molded whereby the runner prevents movement of the semi-completed article in the opposite direction to thereby lock same in place, means for replacing said core means with other core means, and means for injecting other plastic material into said mold, whereby a composite article is formed.

2. An apparatus for producing plastic articles from a multiplicity of plastics which consists of a mold having core members defining a cavity, means for injecting plastic material into said cavity to fill a portion thereof, means for retaining the molded article in said mold, means for removing the sprues and runners from said mold, means for changing the core members within the molded article to alter the shape of the cavity therein, and means for injecting another plastic into said altered cavity through the cleared sprue and runners.

3. An apparatus for producing plastic articles from a multiplicity of plastics which consists of a mold having a sprue opening and a runner passage, core members movable into and out of said mold for defining a cavity, means for injecting plastic material into said cavity, means for opening said mold for withdrawing said core members, means for retaining the molded article in the mold, means for ejecting the sprue and runner from said mold, means for closing said mold and inserting new core members within the molded article to provide an altered die cavity in cooperation therewith, and means for injecting another plastic material into the altered die cavity through a cleared sprue and runner to form a composite article.

4. An apparatus for producing plastic articles by a multiplicity of injections into a die cavity which consists of a mold, means for injecting successive changes of plastic material into said mold, removable core members for said mold, means for changing the core members in said mold for altering the shape thereof subsequent to each injection and in a predetermined sequence, means for retaining the injected article within said mold during changes of said core members, and means for ejecting the completed plastic article and the

sprues produced in molding from said mold in opposite directions.

5. A plastic injection machine for injection molding composite articles from a plurality of plastic materials comprising a turret, a plurality of molds carried by said turret, a pair of bolsters movable with respect to each other and with respect to said turret positioned adjacent opposite sides of said turret, power means connected to one of said bolsters for retracting the same from said turret, resilient means between said turret and the other of said bolsters to separate the same, a plurality of injection cylinders associated with said other of said bolsters, said power means moving said bolster carried thereby into engagement with said turret and compressing said resilient means to engage said turret with said other bolster to close said molds and advance the unit into engagement with said injection cylinders.

6. A plastic injection machine for injection molding composite articles from a plurality of plastic materials comprising a turret, a plurality of molds carried by said turret, a pair of bolsters movable with respect to each other and with respect to said turret positioned adjacent opposite sides of said turret, power means connected to one of said bolsters for retracting the same from said turret, resilient means between said turret and the other of said bolsters to separate the same, a plurality of injection cylinders associated with said other of said bolsters, said power means moving said bolster carried thereby into engagement with said turret and compressing said resilient means to engage said turret with said other bolster to close said molds and advance the unit into engagement with said injection cylinders, means for ejecting plastic material from said injection cylinder into said molds to form an article in said molds having a runner extending therefrom, means in said mold for preventing the movement of the article in one direction in the mold, said runner preventing movement of the article in the opposite direction to thereby lock same in place, and means for cushioning the engagement of said bolsters with the injection cylinders.

7. A plastic injection machine for injection molding composite articles from a plurality of plastic materials comprising a turret, a plurality of molds carried by said turret, a pair of bolsters movable with respect to each other and with respect to said turret positioned adjacent opposite sides of said turret, power means connected to one of said bolsters, resilient means interposed between said turret and the other of said bolsters for urging separation thereof, a plurality of injection cylinders associated with the other of said bolsters, said power means clamping said turret and molds between said bolsters and advancing the same as a unit into engagement with said injection cylinders, and means for cushioning the engagement of said bolsters with the injection cylinders, said cushioning means causing separation of said bolsters and said turret as a unit from said injection cylinders, said resilient means causing separation of said turret from said one bolster upon retraction of said other bolster by means of said power means.

8. A machine for producing composite plastic articles from a plurality of plastics injected into a common mold cavity by successive injections comprising a rotatable turret carrying a plurality of molds that are movable toward and away from an injection cylinder, a plurality of injection cylinders spaced from said turret and circumpositioned about the axis thereof, means for closing said molds, said last mentioned means also moving said closed molds into engagement with said injection cylinders, means for ejecting plastic material from said cylinders and into said molds, means for indexing said turret in one direction into successive positions adjacent said injection cylinders, and control means actuated by complete retraction of said mold closing and advancing means for initiating operation of said indexing means.

9. A machine for producing composite plastic articles form a plurality of plastics injected into a common mold cavity by successive injections comprising a rotatable turret carrying a plurality of molds that are movable toward and away from an injection cylinder, a plurality of injection cylinders spaced from said turret, means for closing said molds, said last mentioned means also advancing said closed molds into engagement with said injection cylinders, means for ejecting plastic material from said cylinders into said molds, means for indexing said turret, control means actuated by complete retraction of said mold closing and advancing means for iniating operation of said indexing means, control means actuated by said indexing means for initiating operation of said mold closing and advancing means, and a second control means actuated by said mold closing and advancing means for initiating operation of said injecting means.

10. A machine for producing composite plastic articles from a plurality of plastics injected into a common mold cavity by successive injections comprising a rotatable turret carrying a plurality of molds that are movable toward and away from an injection cylinder, a plurality of injection cylinders spaced from said turret, means for closing said molds, said last mentioned means also advancing said closed molds into engagement with said injection cylinders, control means for timing the cycle of operation of said mold closing and advancing means, means for ejecting plastic material from said cylinders into said molds, control means for timing the cycle of operation of said injecting means, means for indexing said turret, control means actuated by complete retraction of said mold closing and advancing means for initiating operation of said indexing means, control means actuated by said indexing means for initiating operation of said first mentioned timing control means, and a second control means actuated by said mold closing and advancing means for initiating operation of said second mentioned timing control means.

11. A mold adapted to be associated with a plastic injection machine for injecting composite articles by a plurality of successive injections of plastic material into a common mold cavity comprising a turret adapted to be associated with the aforesaid machine, inserts positioned in said turret, a mold cavity through each of said inserts, closure plates positioned adjacent opposite sides of said turret for closing said mold cavity, and a plurality of core means carried by said closure plates for successive association with each of said mold cavities when said turret is rotated in successive steps to successively alter the contour of each of said cavities and permit production of a composite article by successive injections of plastic material into the successive cavities formed by said core means.

12. A machine for injection molding a composite article from a plurality of plastic materials by injecting the materials into a common mold cavity comprising a plurality of molds car-

ried by a turret, a plurality of injection cylinders, means for advancing said molds into successive engagement with said injection cylinders, means for cutting the runner from the molded article produced by each injection while in the mold, and means ejecting said runners and the sprue connected thereto before a subsequent injection into the common mold cavity.

13. A machine for injection molding a composite article from a plurality of plastic materials by injecting the materials into a common mold cavity comprising a plurality of molds carried by a turret, a plurality of injection cylinders, means to rotate said turret for advancing said molds continuously in one direction into successive engagement with said injection cylinders, means reciprocable into engagement with said molds for cutting the runner produced by each injection, means reciprocable in the opposite direction to said cutting means for ejecting said runners and sprue associated therewith prior to a successive injection, and means for retaining the injected article within said mold when ejecting the sprue and runners therefrom.

14. A method of injection molding composite plastic articles from a plurality of plastics by successive injection into a common mold cavity which consists of providing a mold cavity of a defined configuration, of inserting core members into said mold cavity for blocking off a portion thereof, of injecting plastic material into the mold cavity formed thereby, of clearing the sprue and runners for the cavity, of removing the core members and inserting other core members of different configuration to thereby produce a new mold cavity having a different configuration, and of injecting another plastic through the cleared sprue into the new mold cavity.

15. A method of injection molding composite plastic articles from a plurality of plastics by successive injection into a common mold cavity which consists of providing a mold cavity of a defined configuration, of inserting core members into said mold cavity for blocking off a portion thereof, of injecting plastic material into the mold cavity formed thereby, of removing the core members, of cutting the runners and ejecting the same with the sprue associated therewith, of inserting other core members of different configuration to thereby produce a new mold cavity having a different configuration, and of injecting another plastic through the same sprue into the new mold cavity.

WARREN R. TUCKER.

Nov. 21, 1967 L. H. MORIN 3,354,249

METHOD OF PRODUCING UNITED DUAL CHARACTER PARTS AND FACING PART

Filed April 17, 1964 2 Sheets-Sheet 1

FIG. 1.

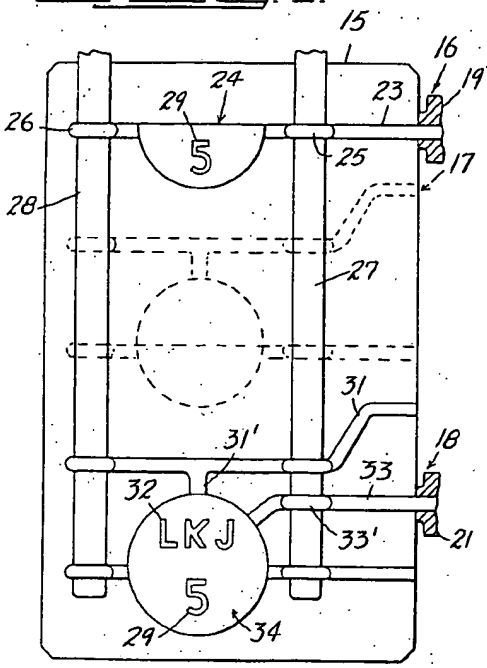


FIG. 2.

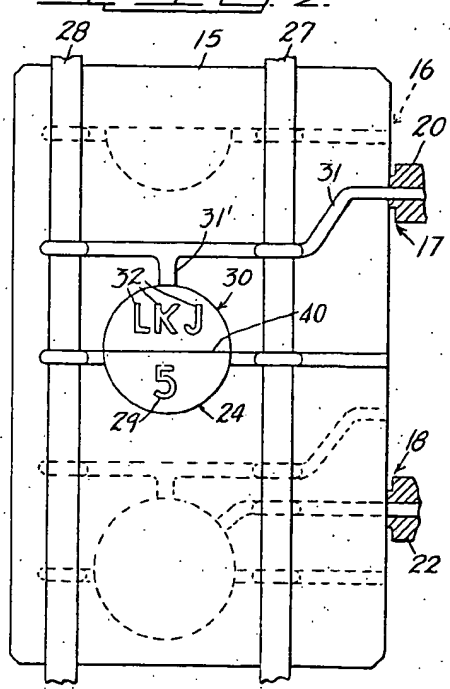


FIG. 3.

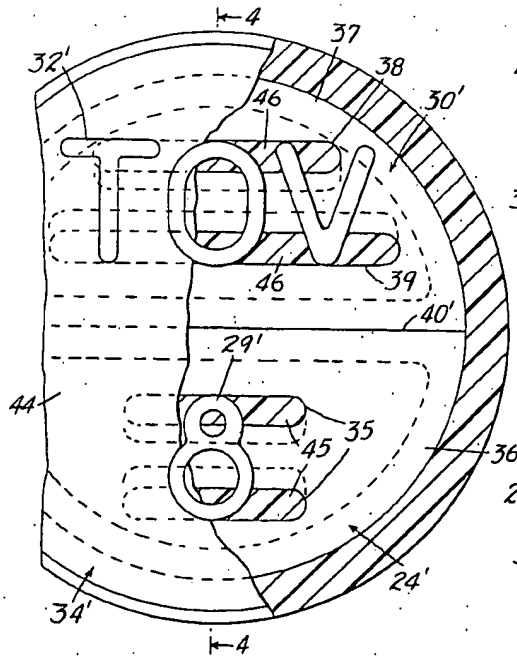
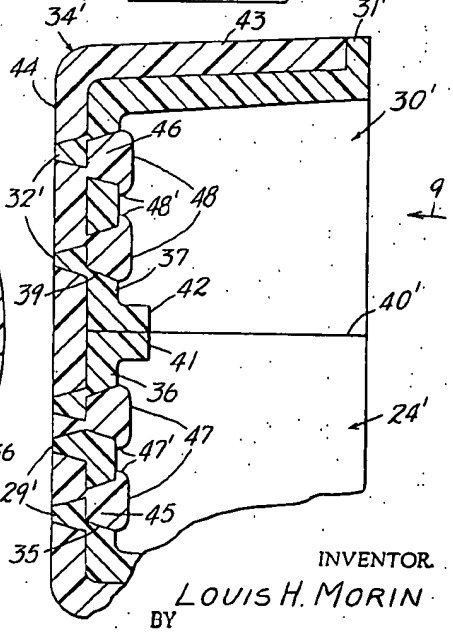


FIG. 4.



INVENTOR.
LOUIS H. MORIN
BY
Howard E. Thompson
ATTORNEY

Nov. 21, 1967 L. H. MORIN 3,354,249

METHOD OF PRODUCING UNITED DUAL CHARACTER PARTS AND FACING PART

Filed April 17, 1964 2 Sheets-Sheet 2

FIG. 5

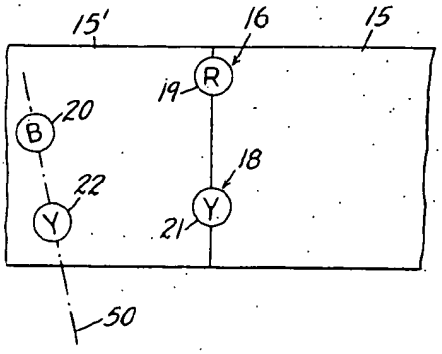


FIG. 6

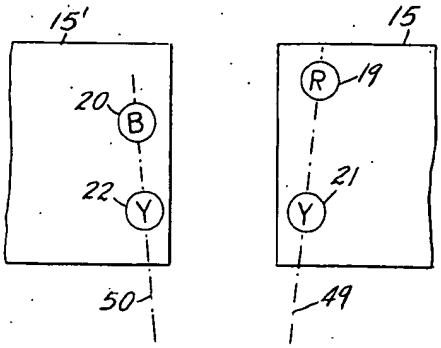


FIG. 7

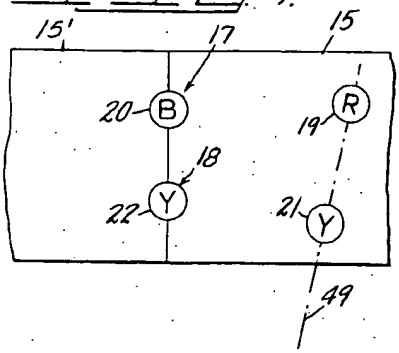


FIG. 8

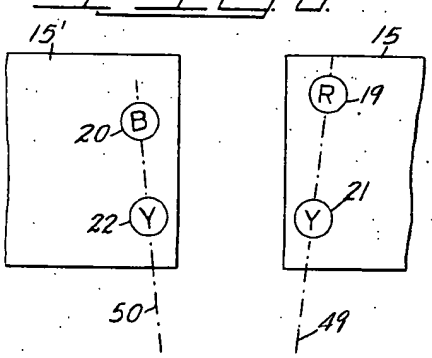


FIG. 10

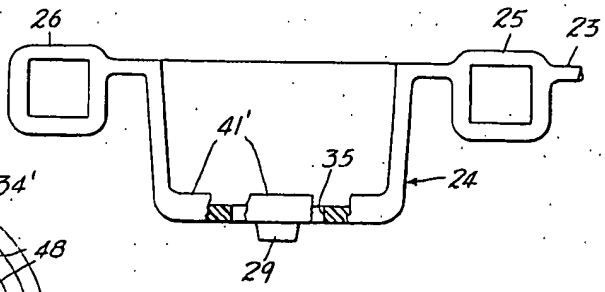
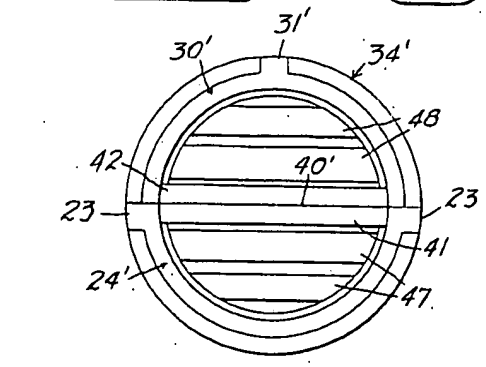


FIG. 9



INVENTOR.
LOUIS H. MORIN
BY
Howard R. Thompson
ATTORNEY

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METHOD OF PRODUCING UNITED DUAL CHARACTER PARTS AND FACING PART

Louis H. Morin, Bronx, N.Y., assignor to Coats & Clark Inc., New York, N.Y., a corporation of Delaware

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This invention relates to the production of united plastic parts of multicolors in production of end products of various types and kinds. More particularly, the invention deals in a method of producing products of the kind under consideration, wherein one character part is formed at a first molding station, a second part is formed on the first character part at a second molding station and, then, the two character parts are moved to a third molding station where a facing part is mounted on both of the character parts in forming a resulting end product in three contrasting colors.

Still more particularly, the invention deals with a method of producing products of the character defined, wherein the third molding station incorporates two injection nozzles intermittently brought into injecting position in successive operations of forming the several parts at the three molding stations.

The novel features of the invention will be best understood from the following description, when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and, in which, the separate parts are designated by suitable reference characters in each of the views and, in which:

FIG. 1 is a diagrammatic face view of one die, illustrating the formation of parts at the first and third molding stations and indicating, in dotted lines, formation of parts at a second molding station not in operation during the formation of the two parts at the first and third stations.

FIG. 2 is a diagrammatic view, similar to FIG. 1, showing the formation at the second molding station, where a second character part is formed upon a premolded first character part and illustrating, in dotted lines, formations at first and second stations, as illustrated in full lines in FIG. 1.

FIG. 3 is an enlarged face and sectional view of a modified form of end product from that illustrated in FIGS. 1 and 2, with part of the construction broken away and parts shown in elevation.

FIG. 4 is a partial section on the line 4—4 of FIG. 3.

FIGS. 5 to 8, inclusive, are diagrammatic views to clearly illustrate nozzle arrangements with respect to dies when in closed and opened positions.

FIG. 9 is a view looking in the direction of the arrow 9, FIG. 4, of a finished and trimmed end product. FIG. 9 being on a reduced scale from that shown in FIG. 4; and

FIG. 10 is a plan view of the first formed character part as at the first molding station, FIG. 1, with the formed part removed from the transfer cores and the dies, with part of the construction broken away and in section.

This application is a continuation-in-part of a companion application filed of equal date herewith, in which companion application die structures for producing products generally in accordance with the present method are disclosed and, for that reason, no detailed showing of the die structures will be illustrated in this application.

In illustrating one adaptation of my invention, I have shown in the accompanying drawings the production of end products, such as keys, buttons or the like, as might be used on various types and kinds of computing machines or typewriters.

Further, in the present disclosure, the end products

are shown as formed of two character parts of different colors and a third facing part arranged upon both of the character parts and in a color contrasting to the colors of said character parts.

In FIGS. 1 and 2 of the drawing, I have shown, at 15, a diagrammatic face view of one die of a pair of dies. In FIGS. 5 to 8, inclusive, I have outlined, for purposes later described, the companion die 15' associated with the die 15.

In FIGS. 1 and 2, I have illustrated at 16 a first molding station, at 17 a second molding station and at 18 a third molding station. At the station 16 is an injection nozzle shown, in part, in section at 19 in FIG. 1 and this nozzle is further diagrammatically illustrated in FIGS. 5 to 8, inclusive, upon which the letter R has been applied to designate the color red, in other words, the color of the plastic material injected through said nozzle. At 20, FIG. 2, I have shown, in partial section, the injection nozzle at the second station 17 and this nozzle has also been identified in FIGS. 5 to 8, inclusive, and, in the showing in these figures, the character B has been applied to designate the color blue, the color of plastic material injected through said nozzle. In FIG. 1 of the drawing, I have shown at 21, in section, one of the nozzles employed at the third molding station and this nozzle has also been identified in FIGS. 5 to 8, inclusive, and has on it the character Y to designate the color yellow plastic material. However, at the third station, an associated nozzle 22 is employed, which in the present illustration, also has the character Y thereon. However, at this time, it is pointed out that, as and when different colors are desirable in the final facing part, the nozzles 22 may inject another color such, for example, as white, green or the like contrasting to the colors of the united character parts formed at stations 16 and 17.

Turning now to the illustration in FIGS. 1 and 2 of the drawing, it will appear that the first molding station 16 has a gate portion 23 extending to a cavity forming the first character part 24, the gating 23 also forming ring-like members 25, 26 on transfer core rods 27 and 28. A clear illustration of 25 and 26 is shown in FIG. 10 of the drawing with respect to the character part 24 which, in FIG. 1 of the drawing, is the numeral FIVE, as seen at 29.

As this same arrangement of rings 25 and 26 takes place at each of the other molding stations 17 and 18, reference at such stations will only be made to the gates to simplify the present description. Again, in the illustration in FIGS. 1 and 2, the formation of the character parts in these figures is only outlined. It will be apparent, however, that each of these character parts will be formed, as later described, in connection with the showing in FIGS. 3 and 4 of the drawing.

Turning now to the second molding station 17, where the second character part 30 is formed, 31 represents the runner leading to the cavity forming the character part 30, the runner, in this instance, including an extension 31'. In FIG. 2 of the drawing, the character part has on its face three characters 32, such as L, K and J, and the character part 30 is shown formed directly upon the character part 24 then positioned at the second molding station. At this time, it is pointed out that, while the molding stations have been identified as where the nozzles inject the plastic material, the products are actually formed where the die elements are located, which form the respective parts.

At the station 18, 33 represents the gate extending to the cavity forming the facing part 34 around both of the parts 24 and 30 then positioned at the third molding station. This will be apparent from the showing of the characters 29 and 32 on the face of the facing part 34 at the third station. The runner structure 30 differs at the third

station by the fact that a single ring 33' is formed on the transfer core rod 27, rather than the dual rings, as at the first and second station.

In FIGS. 3 and 4 of the drawing, I have shown in enlarged detail and partial section a finished and trimmed end product and, in these figures, 24' represents a character part, generally similar to 24, 30' a second character part, similar to 30. The only difference between the two parts shown in FIG. 3 of the drawing is that the part 24' has the numeral EIGHT thereon, as indicated at 29'; rather than the numeral FIVE and the character part 30 has the letters T O V thereon, as indicated at 32'; rather than the L K J. Otherwise, these parts will be of identical construction, in other words, the character parts 24, 24' will have formed therein two elongated apertures or passages 35 disposed centrally of the outer character supporting wall 36 of the parts. The character parts 30, 30' will have on the character supporting wall 37 thereof a short elongated aperture or passage 38 and a longer aperture or passage 39, as clearly illustrated in FIG. 3. The parts 24, 24'; 30, 30' are both semi-cupshaped or thimble-shaped in form and these parts, when united at the second molding station, abut, as indicated by the line 40, FIG. 2, and 40', FIGS. 3 and 4. It will also appear, from a consideration of FIGS. 4 and 10, that the front walls of the two character parts, for example, the walls 36 of 24' and 37 of 30', have, at the abutting surfaces 40'; inwardly projecting flanges 41 and 42 to provide wider surface engagements at these front walls, the flange of the part 24 being illustrated at 41' in FIG. 10.

Considering FIGS. 3 and 4 of the drawing, it will appear that the facing part 34' includes a housing portion 43 enveloping the periphery of the parts 24', 30', as clearly noted in FIG. 4. The facing part also includes a front wall 44 arranged over the surface of 36 and 37 of the parts 24', 30' and around all of the characters of the character parts 24', 32', as clearly noted in FIGS. 3 and 4. The outer wall 44 includes portions which extend through the apertures 35, as seen at 45 in FIG. 3, and through the apertures 38 and 39, as seen at 46 in said figure. The portions 45 and 46 also extend onto and overlap the inner surface of the walls 36 and 37 to form anchor bar portions or elements 47 and 48, the overlapped flange portions of said bars 47 and 48 being clearly illustrated at 47' and 48' in FIG. 4 of the drawing. This securely keys and anchors all of the parts against relative movement and separation. The bars 47 and 48 are clearly illustrated in FIG. 9 of the drawing and, in this figure, I have also illustrated the trimmed-off gate portions 23 of the character part 24, 24' and the trimmed off gate extension 31'. In this connection, it will be apparent that the gate 33 is trimmed from the surface of the facing part 34 and this would not appear on the showing in FIG. 9 of the drawing. The trimmed gate 31' is illustrated, in section, in FIG. 4 of the drawing.

The method of procedure in forming the united character and facing parts will be clearly understood from a consideration of the schematic showing in FIGS. 5 to 8 of the drawing, from which it will appear that the nozzles 19 and 21 are jointly moved along a common swivel member illustrated by the dot-dash line 49, illustrated in FIGS. 6, 7 and 8 of the drawing; whereas, nozzles 20, 22 jointly swivel along the dot-dash line 50 of FIGS. 5, 6 and 8.

It will appear that, in the first injection in the operation of the machine from the illustration in FIGS. 1 and 5, a character part 24 is formed at the first station 16 and simultaneously a blank is formed at the third station. Here, it is, of course, to be borne in mind that, in continued operation of the machine, when the facing part 34 is formed at the third station, the two character parts 24 and 30 will then be positioned at such third station in the molding of a complete product. In this first cycle of operation, it will appear that the nozzles 20, 22 are abutting the surface of the die 15' simply to keep the ends of

the nozzles closed and the machine is controlled, so that no injection of material takes place when 20 and 22 are in the position shown in FIG. 5.

Now, in the transfer stage, in other words, when the character part 24 and the resulting assemblage at the third station are moved relatively to the dies, when the dies are opened as seen in FIG. 6, all of the nozzles will be sealed off on the surfaces of the dies and the character part 24 is moved to the second station, as shown in FIG. 2, and the completely formed assemblage will have been moved to a stripper and trimming station beyond the lower surfaces of the dies in accordance with known practices in the art and this is illustrated, in part, by the extended projection of the transfer cores 27 and 28 in FIG. 2 of the drawing.

The dies 15, 15' are then closed with 20 and 22 moved into the position shown in FIG. 7 and, in the next cycle of operation of the machine, plastic material will be injected at the second station to form the character part 30 on the character part 24 then positioned at the second station and a blank part which would then have been moved to a third station will have a facing part formed thereon by injection through the nozzle 22 rather than the nozzle 21, as clearly indicated by the showing in FIG. 7 of the drawing. The color can be the same as injection through the nozzle 21 in FIG. 5 or of a contrasting color, as previously stated.

In this second cycle of operation, the nozzles 19 and 21 are supported on the surface of the die 15, as shown in FIG. 7, and no injection of the material takes place through these nozzles. Immediately after the second cycle of operation, the dies are again opened, as illustrated in FIG. 8 of the drawing, all of the nozzles are sealed off on the surface of the dies 15, 15', the transfer cores 27 and 28 are again moved downwardly, having been returned to the position of FIG. 1 at the beginning of the second cycle of operation, and the assembled parts 24, 30, as formed at the second station, are transferred to position in the third station, whereupon, the dies 15, 15' are again closed, returning the parts to the position shown in FIG. 5, with the nozzles 19, 21 again in position to form the next successive character part 24 at the first station and facing part 34 at the third station. Thus, a completed three color product may be formed.

From here, the cycle of operation, above described, is repeated in producing in each cycle of operation of the machine a finished and trimmed end product, such as shown, for example, in FIGS. 3, 4 and 9 of the drawing.

Each product which comes off the third position, i.e., lowermost position in FIGS. 1 and 2, is not a perfect product (herein called a "blank") and a certain percentage has to be discarded. However, the remaining products are as described in the application and the method followed is as described. If there is no composite article made up of 24 and 30, removed from the middle cavity to the lowermost one, then the next injection will not make a complete article. It will have to be discarded. However, where there is a complete article made up of 24 and 30, moved into the third or lowermost cavities, a perfect end result is obtained. If the articles in question are made of metal or thermoplastic, the imperfect ones may be remelted so there is very little waste of the material.

In formation of the various end products, it will be understood that the die elements employed for forming the character parts can be changed from time to time in production of the desired characterizations on the resulting end products in accordance with the teachings in the companion application referred to heretofore. It will also be apparent that the shape and contour of the resulting end product can be of any particular design and cross-sectional contour, depending entirely upon the character or product produced. Here, it is to be kept in mind that the characterizations can be designs or insignia of any type and kind.

Considering FIG. 4 of the drawing, it will be seen that, in addition to the flange portions 47', 48', the bar portions or elements 47 and 48, where they pass through the apertures 35, 38 and 39, as at 45, 46, flare inwardly, which result is accomplished by correspondingly tapering at least the upper and lower walls of said apertures. It will also be apparent, from a consideration of FIGS. 1 and 2 of the drawing, that the formation of the end products is entirely automatic from the standpoint that the part 24 is delivered from the station 16 to the station 17 by the core rods 27, 28. Further, these rods also deliver the assembled parts 24 and 30 from the second station 17 to the third station 18 and, still further, from the third station 18 to the trimming station, which is not shown for reasons previously stated. This automatic operation not only results in the production of better end products but economizes on the production of such products.

In accordance with the method herein disclosed, a unique die structure is provided, wherein the first character part 24 is formed at the first station and the second character part 30 is formed at the second station and, at said second station, these two half parts are united to form what might be termed a cup-shaped character assemblage. Thus, when this assemblage is moved to the third station, the outer facing or casing part is formed upon the assemblage of the first and second parts. No detail showing of the cavity forming portions of the dies at the respective stations is illustrated, but this would be well understood by those skilled in the art from a consideration of the various parts produced at the respective stations and as illustrated in FIGS. 3, 4, 9 and 10 of the drawing, particularly bearing in mind the more detailed illustrations in the companion application filed of equal date herewith.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of producing united plastic character and facing parts in different colors in a resulting end product, which consists in providing pairs of plastic injection nozzles simultaneously moved into injection position between a pair of dies having three molding stations, one pair of nozzles injecting plastic material simultaneously into a first and third station in forming one character part and one facing part, then, in another cycle of operation, moving the other pair of nozzles into injection position to inject material simultaneously into the second and third stations to form a second character part at said second station upon a first character part then positioned at said station, as well as to form a facing part on two character parts positioned at said third station, supporting the first pair of nozzles in inoperative position during said last named cycle of operation, then, in the next cycle of operation, again moving the first named pair of nozzles into injection position, with the second pair of nozzles supported in operative position, forming another first character part at the first station and a facing part on the two previously formed character parts then positioned at said third station, and forming the resulting end product comprising the three united parts by trimming the three united parts at a trimming station.

2. A method as defined in claim 1, wherein each of the character parts are formed with character supporting walls having passages therein opening through inner and outer surfaces of said walls, and extending the material of the facing part through said passages to dispose parts of the facing material upon inner and outer surfaces of said walls of the character parts in retaining all of said parts against relative movement.

3. A method as defined in claim 1, wherein each of the character parts include portions formed on transfer rods for movement of the first character part to the second station and the second character part to the third station and the assembled character parts from the third station to a trimming station.

4. A method as defined in claim 1, wherein employment of a nozzle in each pair registering with the third station in each cycle of operation results in production of a finished assemblage of united parts at the third station in each cycle of operation including a finished end product.

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ROBERT F. WHITE, *Primary Examiner.*

EUGENE R. CAPOZIO, *Examiner.*

W. GRIEB, T. J. CARVIS, *Assistant Examiners.*